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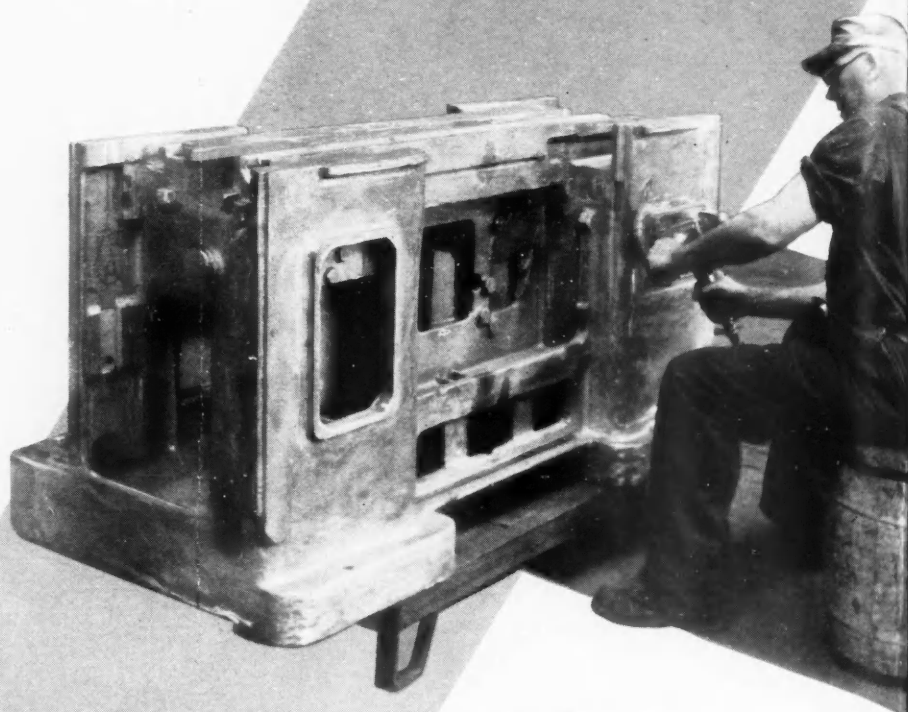


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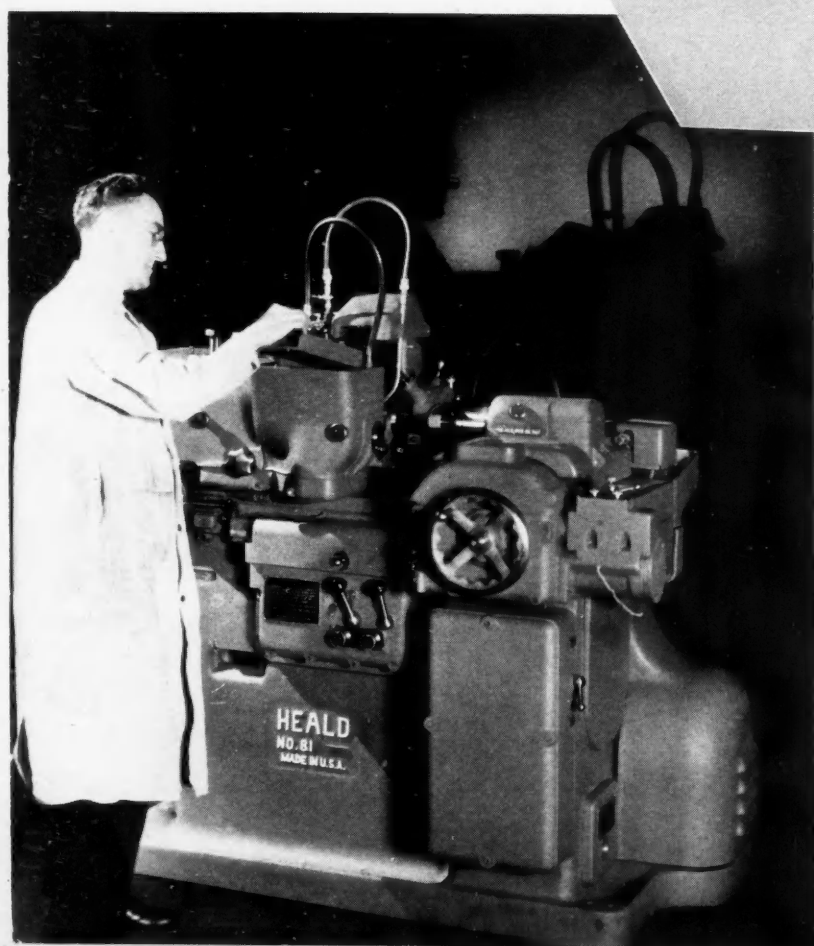
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AUTOMOTIVE INDUSTRIES

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Reg. U. S. Pat. Off.
Published Semi-Monthly

Volume 82

Number 10

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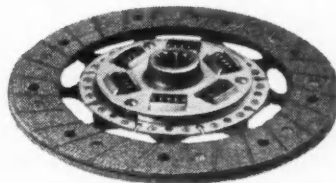
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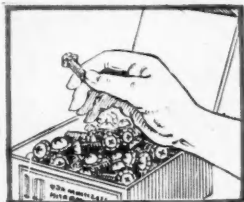
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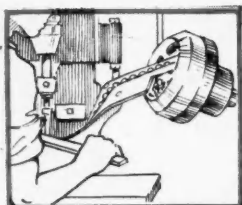


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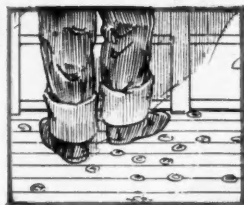
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lock washers on screw

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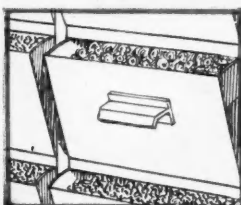


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May 15, 1940

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IN THIS ISSUE . . .

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Volume 82 May 15, 1940 Number 10

YEAR after year new developments in the design of automobiles have made their first appearance at the annual Indianapolis Race. For weeks before the speedway world has been more or less agog in attempts to squeeze out a little more mileage and speed as well as to increase the stamina of the many models that aspire to start in the great classic.

The atmosphere surrounding the entries is teeming with new things again this year as it has in the years



Robert T. Jackson on the job at Indianapolis for Automotive Industries

gone before. Many of these are ultimately going to find their way to the big production lines. They are now pointing the way of development for the models of tomorrow. Important indeed therefore is this laboratory for automotive design.

In the June 1 issue of AUTOMOTIVE INDUSTRIES there will be drawings, photographs and description of many of these new ideas in an article by Robert T. Jackson that will be ripe with data on the things that may ultimately be under the hood of some of the popular makes of cars.

Automotive Industries

GENERAL

Futurama; 1940 Model

Page

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With the opening of the New York World's Fair the Futurama of the General Motors goes into a revised form for its second season of promotion for roadways keyed to the new order of life. Reactions of the public from last year's viewings have set the pace for the changes that have been made. Just what those reactions were and what they have brought about in the famed exhibit are of particular interest to the automotive field.

FUELS

Atlantic Tests Produce New Fuel Data

450

The Atlantic Refining Co. has been making some fuel tests in Florida using twelve of the big three popular makes of automobiles. Miles per hour, acceleration, octane requirements, and total mileage in many respects take on a new meaning. It is interesting as well as informative reading.

DIESEL

Governing of Diesel Engines

456

Here is an article by O. F. Zahn, Jr., that adds considerable to the material at hand in regard to the Diesel engine. With the growing interest and use of the Diesel this should be of particular interest.

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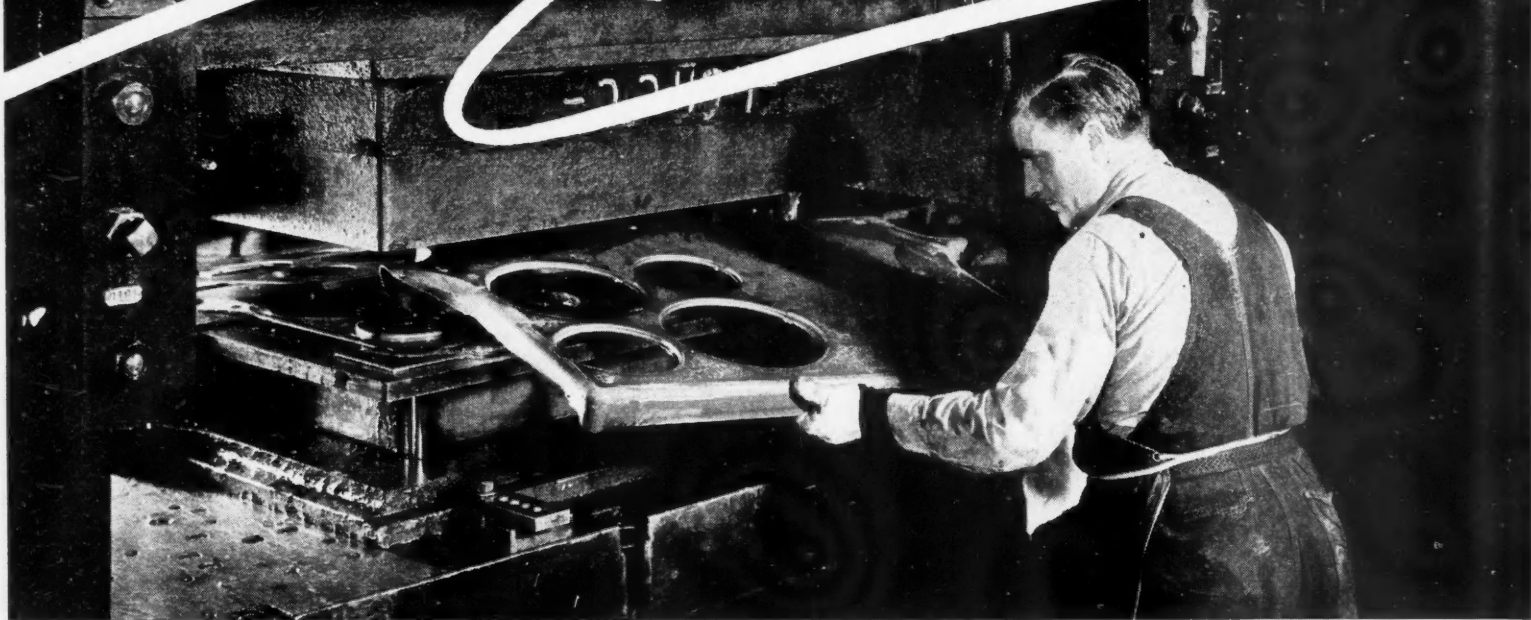
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May 15, 1940

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AUTOMOTIVE INDUSTRIES

Published on the 1st
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Vol. 82, No. 10
May 15, 1940

Futurama: 1940 Model

Even a speculative view of tomorrow's world must be tailored to public taste, according to the experience of Norman Bel Geddes and General Motors, who have refurbished the World's Fair's No. 1 attraction for this year's "friendly fair"

A LIMITATION in educating the public is the necessity of dramatizing facts with utmost impact and simplicity. Practical, factual details must often be skimmed over or omitted entirely. That was and still is the limitation imposed on the General Motors Corporation's, by now the nationally famous, "Futurama" at the World's Fair. But as it begins its second successful season of public education in highway design as related to better and faster motor cars, it remains foremost among efforts to create a better world and better automobile business for everybody. During the 1939 Fair, more than 5,000,000 persons passed through the Futurama, more than attended any other exhibit, and yet this total might have been doubled but for the limitation of capacity.

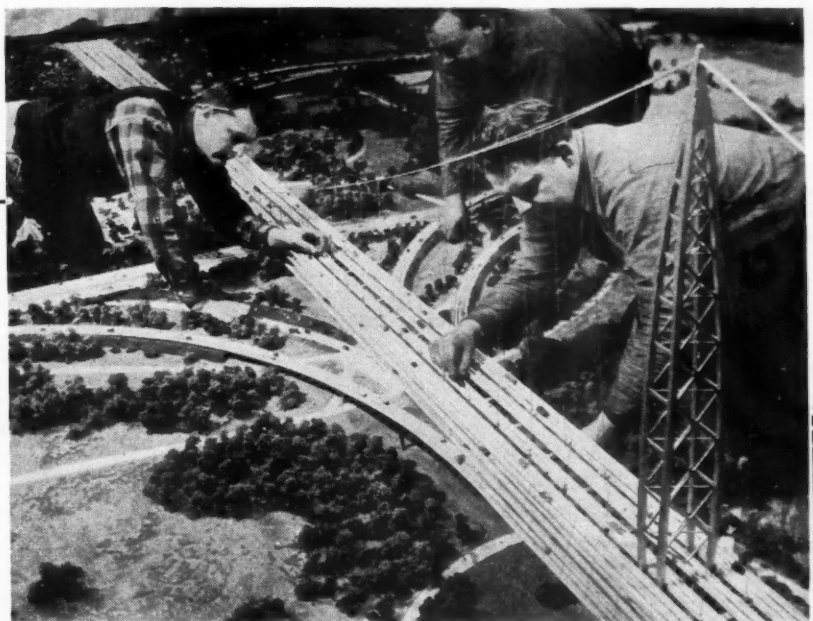
As this second season of the Futurama opens it is interesting to "take stock" of results in terms of propaganda value for the motor

vehicle industry, for whatever the Futurama may accomplish is likely to help the entire automobile business as well as General Motors.

In the interval between the first season's showing and the present, public criticisms and suggestions were received and acted upon, indications of the Futurama's influence from coast to coast. So far, though, there has been no evidence of a far-reaching inspiration for reform in highway building.

An early public reaction was both entertaining and slightly disappointing. Having viewed the Futurama last year, two clergymen at remote points, one in Arkansas and the other in Brooklyn, N. Y., delivered sermons. The subject in both cases was what had ap-

More churches . . . more gas stations . . . more land under cultivation . . . no billboards . . . more vehicles moving. Workmen on the GM Futurama change a future world to meet the suggestions of various "pressure groups" which insist that tomorrow's world would be incomplete without their pet ideas.



EXPOSITION

peared to them as a "Godless World of the Future" as depicted by General Motors Corp. They dwelt on the lack of churches in the world of the Futurama. Their own lack of observation was partly at fault, for by actual count, the designer, Norman Bel Geddes, had included 132 churches of various sizes and importance. The criticism has had its effect, however, and this year there are several hundred churches, which it is hoped will call for fewer adverse sermons.

The next criticism was lack of gas service stations. Like the churches these, too, had been carefully spotted on highways and feeder roads, but were not labeled as such. So, the "literal Lymen's" among motorists failed to recognize the service stations of tomorrow. When the General Motors Corp. announced as a result of these comments, that the gas stations would be "highlighted" in this year's showing, there was an immediate and unexpected public reaction. An Anti-Billboard association, assuming the world of the future would be decorated with large signs and 24-sheet billboards, according to the dispensation of General Motors, started a chain letter of complaint. The chain was nipped in the bud by the further explanation that "highlighting" was a theatrical term and had nothing to do with billboards but merely called for increased focus of light on these points. A number of middle western and far western farmers called the company's attention to the small proportion of tomorrow's world that was under cultivation and the large percentage of scenic territory. This year, "Farmer" Norman Bel Geddes, "sharecropping" with the General Motors Corp. on a stretch of territory one-third of a mile long, has increased farmlands.

Obviously, these public reactions are comparable to those of the layman who is asked to express his opinion of a great painting, and responds by complaining about the width, color and decoration of the frame. They are typical of the experiences of Hollywood in producing motion pictures in which almost invisible details were incorrect.

On the credit side of the Futurama's ledger might be placed the experience of several Chambers of Commerce in the West, which have been engaged in crusades for better city planning. These have used photographs and facts about cities from the Futurama including at least some reference to bigger and better highways. Then, there are many men in public life who have been duly impressed with the message conveyed and, it is claimed, that at least two short stretches of highway constructed since the Futurama have been influenced by the idea in part. One of these is on Route 25 in New Jersey and the other is a part of the Harrisburg to Pittsburgh superhighway in Pennsylvania.

Regardless of the kind or source of the criticism, however, the Futurama has accepted it, and this year's showing includes not only more churches and gas stations and farm lands but a new University City with athletic fields and ultra-modern buildings. Throughout, moving parts have been increased, especially the number of tiny moving motor cars on the highways. Lighting has been improved and made more dramatic with theatrical gauze used in various places to give depth and the perspective of greater distance.

But, even though there are indications that highway building has been influenced by the Futurama message and city planners are using it for promotion of their ideas, the fundamental idea of centrally planned highway expansion for the entire country seems still waiting to be "sold" to the public. It is this idea that is covered in Norman Bel Geddes recent book, titled "Magic Motorways." In its pages, the factual detail that must be slurred over or omitted in a spectacle such as the Futurama, is provided for those interested in more than glittering and spectacular generalities.

Unfortunately, such a book cannot be handed out with each free entrance to the Futurama, or even be given on request to interested parties. If it could, the effect on public opinion about highways and motor vehicles (Turn to page 492)

The Brass-Hat Rack



"What I want is a steering wheel with NO spokes!"

BUSINESS IN BRIEF

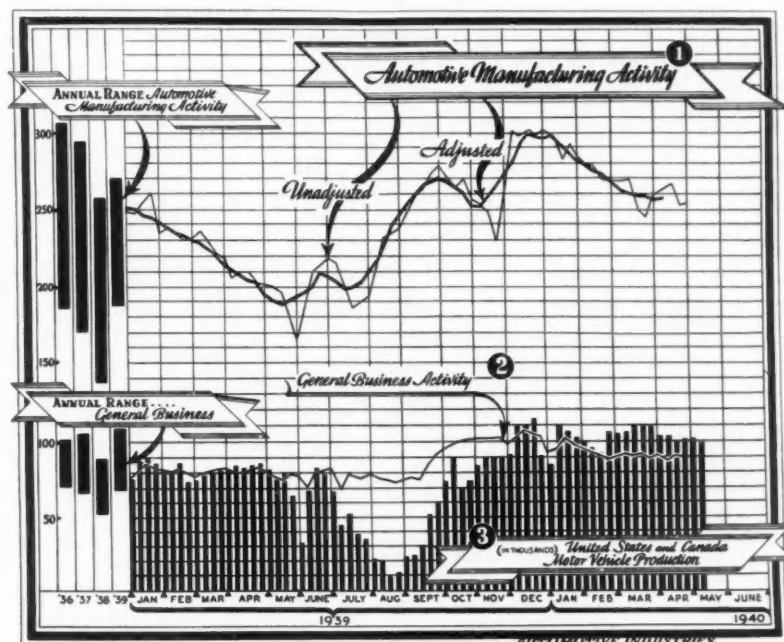
*Our own view of automotive production and sales;
authoritative interpretation of general conditions*

PRODUCTION in the motor car and truck industry continued to run well ahead of 1939 during May, even with the seasonal decline in manufacturing schedules. Production for the first half of May was estimated at approximately 212,000 units, but output for the second half of the month was expected to be considerably below that figure due to the Memorial Day holiday. Coming on a Thursday, that will cut two working days from the month's total, bringing it down to 21 days. Nevertheless, the month's output is expected to be considerably higher than May, 1939, when 313,214 vehicles came off the production line.

For the week ending May 11, production was estimated at approximately 96,000 units, which was slightly lower than the previous week. Chevrolet continued to pace the entire industry, as well as the General Motors group, whose weekly output was off fractionally to 43,300 units. Ford turned out 18,500 vehicles, while Chrysler, with Plymouth and some Dodge plants on a four-day schedule, accounted for 20,300 units. Studebaker topped the independents, followed by Packard, Hudson, Nash, Willys and Graham.

April production of 447,400 motor cars and trucks by A. M. A. estimate, exceeded every 1940 month except January, when 449,314 units were produced. April output was 20.8 per cent above April, 1939, and brought the production total for the first four months of 1940 to 1,758,445 vehicles, 24 per cent over the similar period of 1939.

¹1923 average = 100; ²Prepared by Administrative and Research Corp. New York. 1926 = 100; ³Estimated at the Detroit office of AUTOMOTIVE INDUSTRIES.



**Weekly indexes of automotive general business
charted**

Holiday Will Cut May Total Output

crease of 27.8 per cent over the 1,163,071 units registered in the first half of the 1939 model year.

Advance reports on April registrations in 98 cities showed retail deliveries 33 per cent ahead of April, 1939, according to Polk.

Reports of retail deliveries by the automobile companies for April confirm this big increase. Chevrolet retail sales for April were 108,362 units, 41 per cent higher than the 1939 month, while Pontiac sales were up 42 per cent. Oldsmobile, Buick and Cadillac reported sales gains ranging from 27 to 34 per cent in April. Nash and DeSoto also showed big gains, DeSoto having the best April sales in its history. Willys deliveries were reported 125 per cent ahead of 1939.

AUTOMOTIVE MANUFACTURING ACTIVITY for the weeks ended April 27 and May 4 showed a change of pace, with activity falling off to the 253 and rising again to the 254 marks, respectively, on the index. The adjusted index curve charted herewith passed through the points 256 and 257 during the weeks ended April 6 and April 14.

Sales figures as revealed in new car registrations continued to keep pace with the higher production schedules. Domestic new passenger car registrations for the first three months of 1940 ran 29 per cent ahead of the corresponding 1939 period, according to R. L. Polk & Co. Production of passenger cars in the same period was up 32.8 per cent. Domestic truck registrations for the first quarter increased 18.9 per cent against a production increase of 11 per cent. Total domestic registrations for the first six months of the 1940 model year, beginning last Oct. 1, were 1,485,863 vehicles, an in-

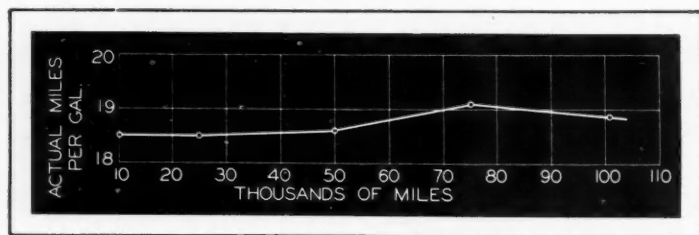


Fig. 1.—Average gasoline mileage of nine cars

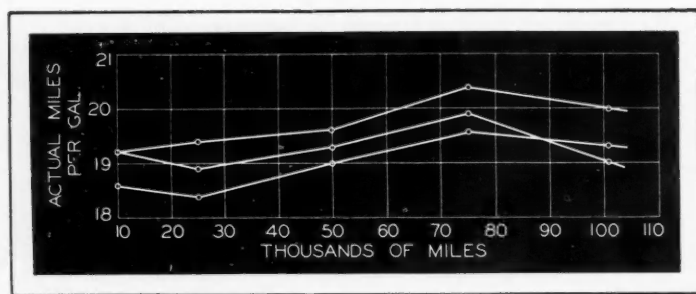


Fig. 2.—Gasoline mileage of individual cars of the same make

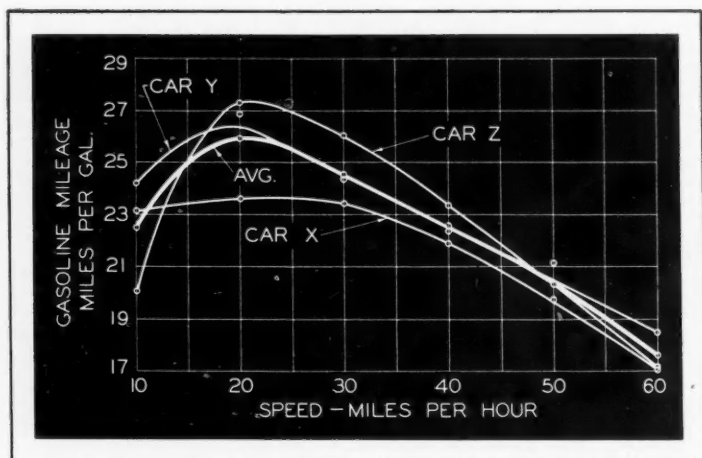


Fig. 3.—Effect of driving speed on gasoline mileage

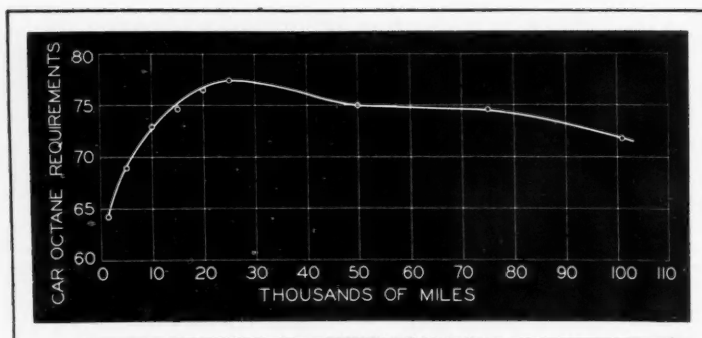


Fig. 4.—Car octane requirements. Nine car average

Atlantic

MOST of our readers no doubt are familiar from newspaper accounts and advertisements with the fact that the Atlantic Refining Company is conducting a severe and extensive road test of 1940 American passenger cars in Florida. It is in a way a repetition of a similar test held over a circuit at Toms River, N. J., five years ago, but the average speed was increased from 40 to 50 m.p.h. It was figured that this higher speed would make fuel and oil requirements more difficult. Because warm-weather conditions could not be obtained in the North during the winter, the test was run over an 85-mile course starting near Palm Beach, Fla., and running along the eastern shore of Lake Okeechobee to a point nine miles north of the town of Okeechobee. Twelve cars were used in the test, four Chevrolet, Ford and Plymouth each. The test began on Jan. 8 and by April 19 each car had been driven more than 100,000 miles, at the rate of approximately 1000 miles per day.

Some results with respect to fuel consumption by these cars were given in a talk by Dr. Thomas G. Delbridge, manager of Atlantic Refining Company's research and development department, at the Franklin Institute, Philadelphia, recently. In the tests, one car of each make is being used to make comparisons of the road performance with various brands of gasoline, while the other nine are being operated on the same gasoline and the same lubricant throughout the test. The results bearing on fuel performance are given in the graphs printed herewith.

Fig. 1 shows gasoline mileage as the nine-car average, obtained when driving at the selected speed—50 m.p.h. average, 55 m.p.h. maximum. It will be noted that the fuel mileage increases with service life up to 75,000 miles, and is greater at 100,000 miles than at the beginning.

Fig. 2 shows individual gasoline-mileage records for three cars of the same make. It indicates that cars made by the same manufacturer, to the same specifications and at the same time, will differ in fuel consumption by as much as 5 per cent, if not more. Here again the fuel mileage grows with service life.

Tests Produce New Fuel Data

Fig. 3 shows the effect of driving speed on gasoline mileage. The three light-line curves show the average for the three cars of each make, while the heavy line curve shows the average for all nine. It will be seen that the gasoline mileage increases with the driving speed up to about 20 m.p.h. and then falls off. At 50 m.p.h. the average consumption is about 20 per cent more than at 20 m.p.h., as the curves also show.

Fig. 4 shows the octane requirements as revealed by the Florida road test. While the average new car required 64 octane fuel, after 10,000 miles the octane requirement had increased to 73, and after 50,000 miles it had leveled off to about 75. No carbon was removed throughout the Florida test, but from results obtained in other experimental work it is concluded that carbon removal after 50,000 miles would have reduced the octane requirement from 75 to about 70.

Fig. 5 shows the average octane-requirement change separately for the three makes of cars tested. These curves are carried only to 25,000 miles, which is the distance in which major changes in octane requirements occur. It will be noted that octane requirements of the three makes of cars differ considerably.

Fig. 6 shows time in seconds to accelerate from 10 m.p.h. to 50 m.p.h., plotted against cumulative car mileage, as the average for the nine cars. This indicates that under such operating conditions as in the test, these 1940 cars can maintain their new-car acceleration for at least 100,000 miles. The improvement of about 8 per cent at 50,000 miles over the 25,000-mile figure is due to the fact that at about 40,000 miles valves were ground on a number of the cars, a practice recommended by the car manufacturer.

Fig. 7 presents separate acceleration curves for each of the three makes. From these it can be seen that there are considerable differences between the different makes, and that in any one make of car there is only a slight change in acceleration in 100,000 miles. Changes in atmospheric conditions seem to have been partly responsible for this slight change during the test.

A second phase of the power tests consisted of a series of maximum-speed tests.

A new Chevrolet, a new Ford, and a new Plymouth, after being carefully broken in at Philadelphia for about 500 miles and over about 1200 miles more on the trip to Florida, were given the Florida-Road-Test lubrication service and the usual manufacturer's mechanical adjustments. This same procedure was applied to one of each of the three makes of cars that

(Turn to page 489, please)

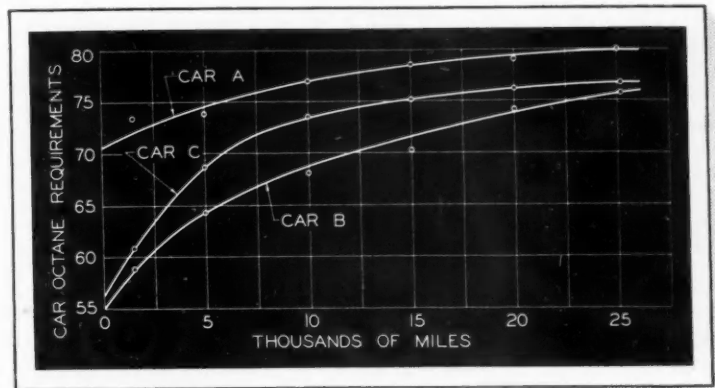


Fig. 5.—Car octane requirements by make. Three car averages

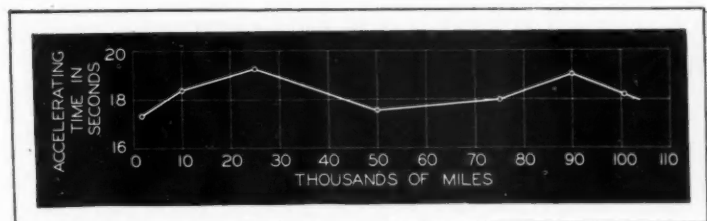


Fig. 6.—Acceleration from 10 to 50 m.p.h. Nine car averages

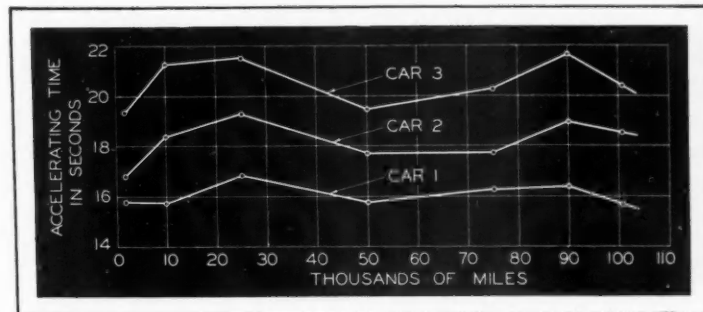
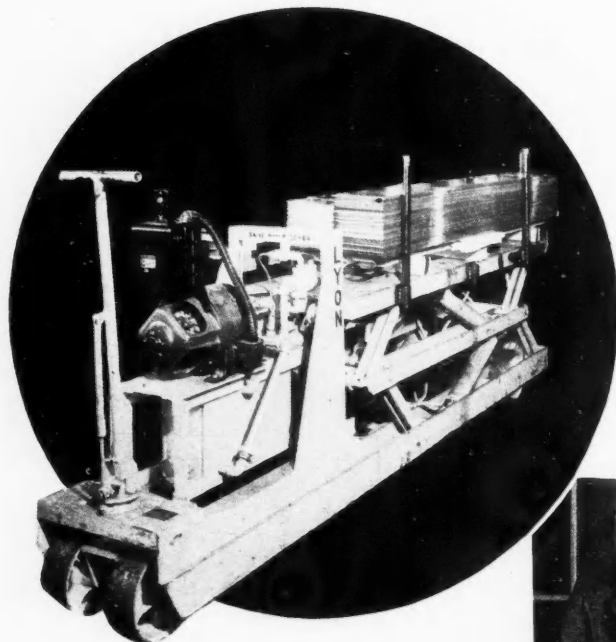


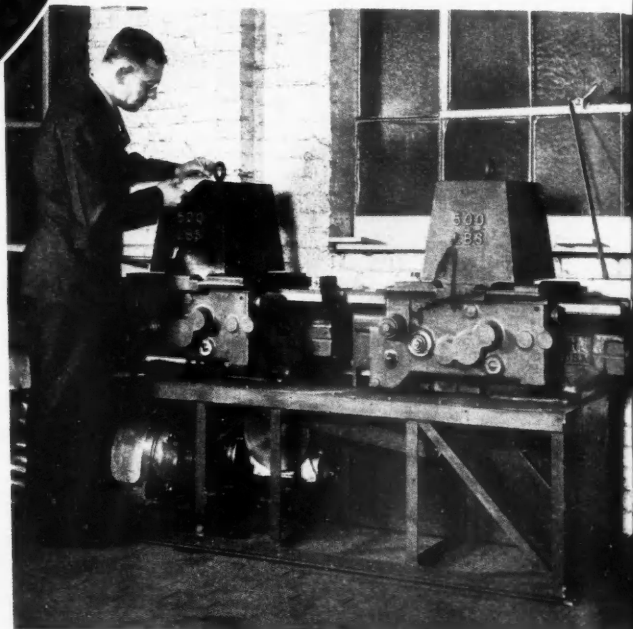
Fig. 7.—Acceleration from 10 to 50 m.p.h. Three car averages

MEN and MACHINES



(Circle) Sheet handling truck with hydraulic elevating table built by the Lyon Iron Works.

(Below) C. A. Bickel, chief engineer, Monarch Machine Tool Co., takes a reading on the comparative breakdown test on flame hardened and unhardened lathe bed ways which has been in operation at the Monarch plant in Sidney, Ohio, for nearly three years.



FOR NEARLY three years the Monarch Machine Tool Co., Sidney, Ohio, has been making a laboratory study of the wear resistance of flame hardened and unhardened lathe bed ways. One comparative breakdown test has been in operation almost continually during this period. The equipment comprises duplicate carriages, each loaded with a 500-lb. weight, which are moved back and forth 20 times a minute over two typical beds, one unhardened, the other flame hardened. To simulate shop working conditions as nearly as possible, dirt, chips and abrasive are applied to the way surfaces of both machines at regular intervals.

Up to the present, it is estimated that the carriages have made about 13,000,000 passes. This is considered equivalent to more than the normal wear which a lathe would get in a lifetime of service. Monarch reports that the unhardened bed ways are scored badly and worn more than a tenth of an inch. The identical flame hardened cast-iron bed ways show no measurable wear.

It was only a few years ago that the flame hardening process, long successful in the heat treatment of small steel parts, was applied to large gray iron lathe bed castings in an effort to solve the costly problem of wear on machine tool ways. C. A. Bickel, chief engineer at Monarch where the process was developed, reports that more than 2000 of the company's lathes with flame hardened beds are now in use in industry and that none shows any scoring or wear.

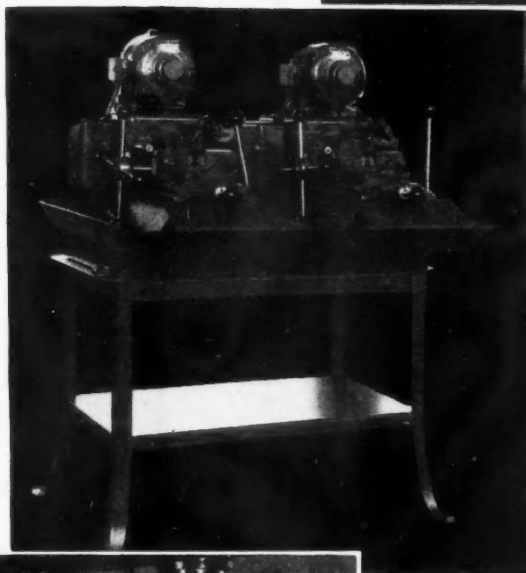
Chrysler Corp. is now using in regular production a special machine developed for ball-burnishing and pre-lubricating valve stem guides in its six-cylinder engines. The operation consists in pressing steel balls through the valve stem guides to burnish them for fine surface finish. As the balls are forced through, the balls and guides are given a shot of colloidal graphite suspended in oil. Apparently minute particles of the graphite are embedded in the surface metal of the guides, providing a certain amount of pre-lubrication.

The machines are operated hydraulically and are built with beds at conveyor height so that cylinder blocks readily slide into them. When the block is in place, the operator merely presses a pedal which releases a steel ball from a tube immediately over each

valve guide. Simultaneously, a shot of graphite oil is squirted into each valve stem guide. Plungers then move down pushing the balls through the guides. The balls drop out through the bottom into a reservoir containing graphited oil and are carried back into hoppers in the machine fixture, ready for re-use. If desired, several balls can be pushed through in turn by merely depressing the trip release a second or third time.

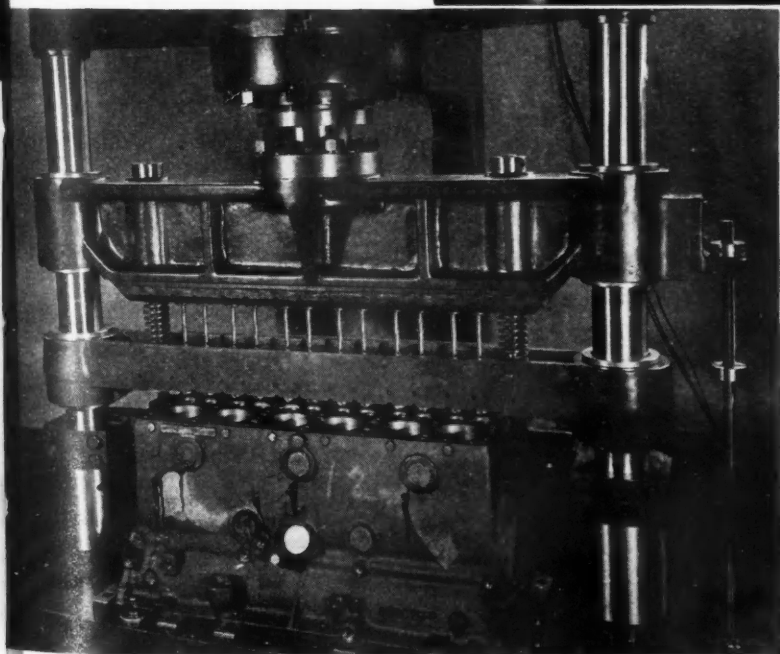
ADDITION of a line of hydraulic straightening presses using "C" type gap frame design has been announced by the Lake Erie Engineering Corp., Buffalo, N. Y.

(Below) Special machine developed by Chrysler for ball burnishing and pre-lubricating of valve stem guides. The plungers under hydraulic pressure force steel balls down through the guides after they are given a shot of colloidal graphite suspended in oil.



(Above) The Brown & Sharpe exhaust attachment for cylindrical grinding which is intended for use with the B & S No. 13 universal and tool grinding machine. The motor-driven device removes grit and dust-laden air from the region of the grinding operation.

(Center) Double spindle threading machine developed by the Geometric Tool Co.



The presses illustrated herewith are rated at 66-ton capacity. Stroke is 16 in. with fast operating speeds of 55 in. per min. closing, 31 in. per min. pressing and 70 in. per min. return. These presses are self-contained with pumping unit enclosed in base. They are adapted for all types of straightening work including finished shapes, such as aircraft parts and similar pieces requiring final straightening after drawing or forming.

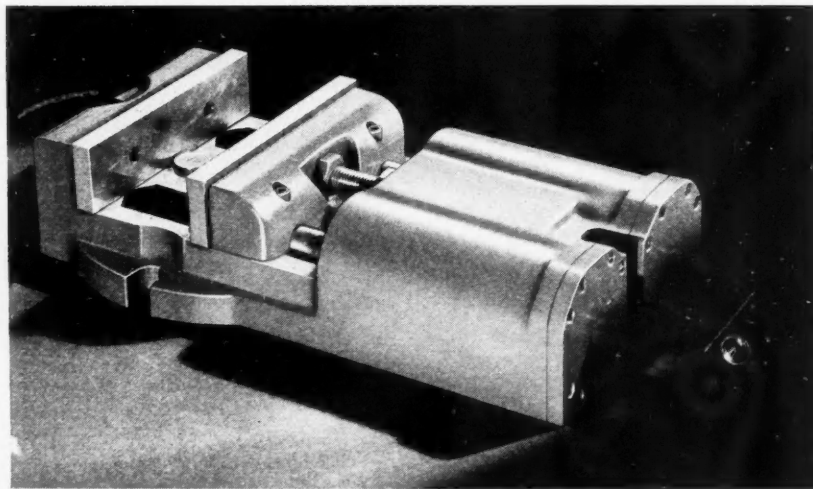
AN exhaust attachment for cylindrical grinding is being built by the Brown & Sharpe Mfg. Co., Providence, R. I., for use with its No. 13 universal and tool grinding machine. The motor-driven device removes grit and dust-laden air from the region of the grinding operation by suction and separates out the foreign matter, leaving the air well-cleaned. It is intended for

use with straight and dish wheels, and may be applied at either end of the wheel spindle.

The B&S attachment includes an exhaust nozzle, flexible suction hose, and a dust collector unit consisting of a motor-driven fan mounted on a separator tank. The dust-laden air is blown into a spiral separator where the heavier particles are removed by centrifugal force, and is then spread by a baffle in an expansion chamber so that it is dispersed slowly over the whole area of the outlet filter, where the remaining finer particles are trapped by two fire-resistant, viscous-coated renewable filter pads enclosed by metal grilles. Capacity of the attachment with a 3600 r.p.m. motor is 300 cu. ft. per min., giving a velocity of approximately 6000 ft. per min. through the 3-in. diameter home.

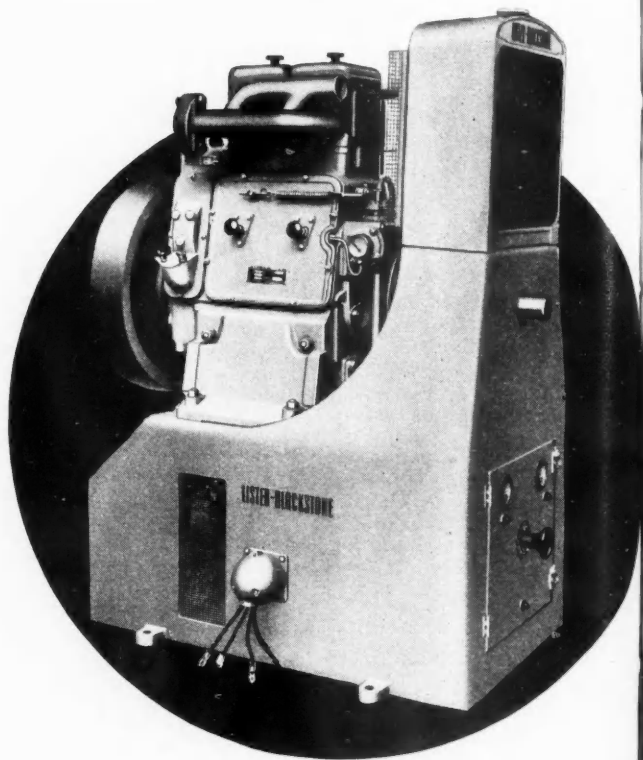
A NEW double spindle threading machine developed by the Geometric Tool Co., New Haven, Conn., can be furnished in three sizes with a complete threading range from 1/16 in. to 1½ in. diameter (national fine thread series pitches only in the larger diameters.) The machine is built up by units, allowing a flexibility of operation not usually found in a double spindle machine. For example, inasmuch as the units are separate, one size of thread may be cut in one unit, another size in the other—each being run at the proper speed for the thread being cut; each supplied with power lubricant from an independent pump; each having an individual chip pan. Also, a right-hand thread may be cut with one unit, a left-hand thread with the other. If desired, only one unit need be operated, thus saving power and expense if it is desired to use the machine as a single spindle machine on short length threading.

THE Lyon Iron Works, Greene, N. Y., recently built a sheet handling truck with hydraulic elevating table designed to keep sheets of steel at convenient heights for operators in feeding sheet metal machines, such as shears, presses, etc. The table of the truck is elevated by four hydraulic rams or hoists, pressure for which is furnished by a hydraulic pump driven by a 2-hp. motor. Lowering of the table is facilitated, particularly when empty, by a separate hydraulic ram. This type of truck can be furnished in various specifica-



May 15, 1940

One of a new line of Diesel-electric power plants, ranging in size from 3600 to 24,000 watts, manufactured by Lister-Blackstone, Inc., Milwaukee, Wis.



tions, although the one illustrated herewith is of 6000 lb. capacity; size of table, 20 in. by 84 in.; lowered height, 22 in.; elevated height, 40 in.; elevation, 18 in.

SINCE its introduction of self-opening die heads with circular ground thread chasers, the National Acme Co., Cleveland, has developed a complete line of end turning, end forming, combination turning and threading cutters of the circular type for use in its standard circular chaser die heads. Because of the savings in tool investment to be gained where one capacity head serves both threading and hollow milling jobs, these tools are designated "Double Duty" Heads.

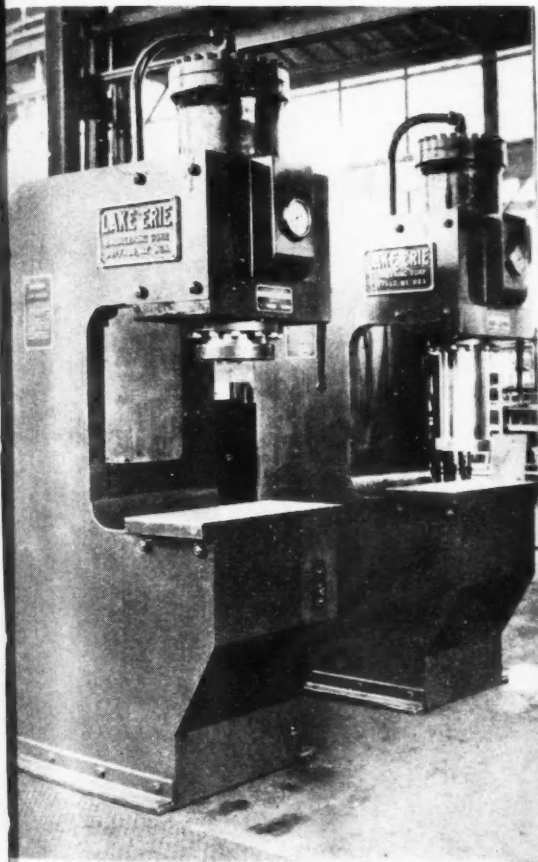
Typical examples of this hollow milling application on production jobs are valve stems, formed gasket seats, upset pipe and a wide class of work having several body diameters, round nose

The Larkin air vise which has been designed primarily for production work and is said to have demonstrated its ability to increase a machine's output as much as 50 per cent on small parts. It is applicable to many manufacturing operations: bench work, drill press work, milling, shaping, planing, and other general machine shop and tool room operations. Manufacturer of the device is the Larkin Industries, Portland, Conn.

ends, etc. Tools for reaming, facing, beveling or chamfering operations also may be inserted in the heads so that these operations are performed at the same time as the regular forming and turning cuts.

Standard heads equipped for hollow milling have the same construction as for threading. Change from threading to hollow milling or vice versa, requires only a change of holding blocks and cutters in the same head. The end cutters, like chasers, are adjustable for diameters. The hollow mill cutters are the circular form tool type, and inasmuch as they are used in multiples, the advantages of fast speeds, smooth turned diameters and uniformity of production is claimed in addition to the double duty feature.

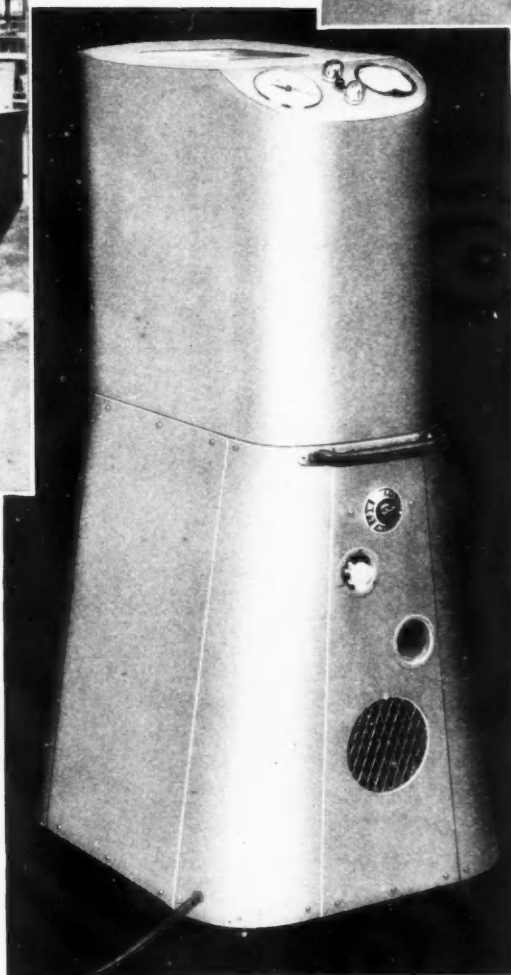
These heads are supplied for both revolving and non-revolving spindle machines for standard and spe-



(Above) Presses of "C" type gap frame design which have been added to the line of equipment built by the Erie Engineering Corp., Buffalo, N. Y.

(Right) Portable cabinet designed especially to meet the requirements of various desiccants used for the control of the moisture content of air and other gases. Pioneer Engineering & Mfg. Co., Detroit, is the builder.

(Right) Using a three-inch working stroke, this press built by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, made 47 complete cycles per minute on its test run. Pressure was built up on the solid bed to a maximum of 250-tons on each cycle.



cial applications. Sizes 1/4 in. to 13 3/8 in.

DEVELOPMENT of a portable cabinet designed especially to meet the requirements of various desiccants (chemical drying agents) used for the control of the moisture content of air and other gases has been announced by the Pioneer Engineering & Mfg. Co., Detroit. One feature of the cabinet is that, after the chemical has absorbed its full quota of moisture, and has become inactive, it can be regenerated quickly within the cabinet, without handling and without any heat arising from the cabinet during the regeneration cycle.

Cabinets of this type can be made in almost an unlimited size range, from a device of only a

(Turn to page 490)

Governing

A DIESEL-ENGINE governor may be defined as an apparatus that decreases the quantity of fuel injected as the speed of the engine increases. Why is every commercial diesel today equipped with a governor? There are three possible reasons. A governor will—

- (1) give close speed regulation while the engine is running unattended under varying load;
- (2) limit the top speed to a safe maximum, and
- (3) enable the otherwise-unstable diesel to idle.

Governors are fitted, as a rule, to accomplish one or more of these objects. Let us examine these in some detail.

The term, "regulation," refers to variations in the engine speed as maintained by the governor at two different loads. It may be expressed either as a difference in r.p.m. or in per cent.

$$\text{Regulation in r.p.m.} = A - B.$$

$$\text{Regulation in per cent} = \frac{200(A - B)}{A + B},$$

where *A* is the highest speed (light or no load) and *B* the lowest speed (maximum load). It is customary to mention the load range in stating the regulation. For example, if the no-load speed of an engine is 1800

r.p.m. and the speed drops to 1700 r.p.m. when a full load is applied, the regulation is 100 r.p.m., or

$$\frac{200(1800 - 1700)}{(1800 + 1700)} = 5.7 \text{ per cent}$$

"between no load and full load."

The smaller the regulation the "closer" it is said to be. At present generator applications call for the closest regulation.

Functioning of the governor to limit the maximum speed is not different mechanically from its action in governing at lesser speeds. If in the preceding example, the safe top speed was 1800 r.p.m., then the governor was also doing its second job, that of keeping the speed within the safe limit, since when all load is removed the speed is 1800 r.p.m. Moreover, close regulation is usually desirable in limiting this top speed, because the latter speed is usually well below that of the peak of the engine power curve. For example, if the engine is used in vehicle work, it is always attended when working, and no regulation is, therefore, required, normally. Yet, if the maximum safe speed is 1800 r.p.m., then full power with 5.7 per cent regulation is limited to that obtained at 1700 r.p.m. If the regulation were 2.8 per cent, the power

at 1750 r.p.m. would be available, which would be more than at only 1700 r.p.m. Thus more power is available the closer the regulation, it being assumed that the safe top speed is determined by the no-load maximum speed and that the rated speed is below the peak of the power curve.

Most diesels are not stable when running without load, especially at low speeds in the idling range, because of the quantity-speed characteristics of the injection system. When no governor is used, a slight increase in speed causes an increase in fuel quantity, which further increases the speed, which again increases the quantity, etc., and the engine races. Or a slight fall in speed causes the quantity to decrease, and the engine stalls. A governor exactly reverses this relationship, and "balances" the speed, holding it at the desired level.

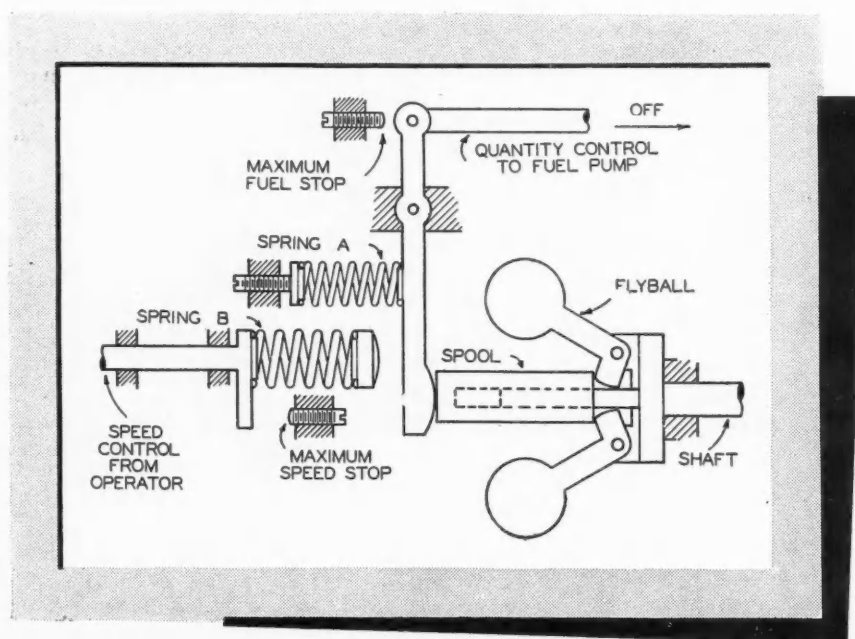


Fig. 1. Common Centrifugal Governor. This is called the "variable-speed" type, since it governs at all engine speeds.

of Diesel Engines

The most popular diesel governor is the familiar centrifugal type, the principle of which is shown diagrammatically in Fig. 1. Consider first that only spring *A* is active, spring *B* being pulled to the left and inoperative. As the speed increases, the flyballs

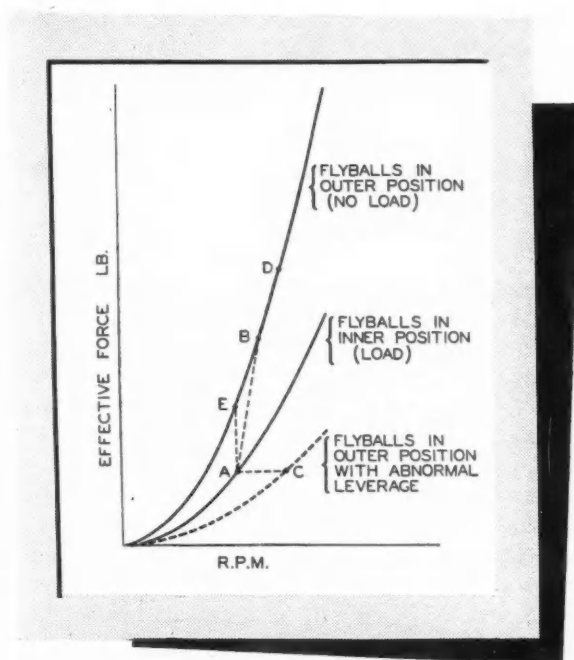


Fig. 2. Speed-Force Curves of Centrifugal Governor. The dashed curve represents a faulty design.

move outward; they move the spool on the shaft to the left, and the quantity control to the injection pump moves to the off position. The speed is a balance between the force of the flyballs and the force of spring *A*, so that increasing the spring force by the adjustment screw raises the speed. The flyball force is given by:

$$F = \frac{W (r.p.m.)^2 r}{35,100}$$

where *F* is the radial force of the flyball in pounds

W is the weight of the flyball in pounds

r.p.m. is the shaft speed

r is the radius of the center of gravity of the flyball from the axis, in inches.

The total effective force acting on the spring will be twice this for both flyballs, times the leverage ratio.

Radial force in any governor varies with the square of the speed and directly as the radius. The effective force acting on the spring need not vary directly with the radius, however, since the leverage ratio between the center of gravity of the flyball and the point contacting the spool may be designed to vary with flyball position in any manner. It is even possible to so design the flyball that the change in its leverage exactly counteracts the change in its radius, so that the effective force is independent of flyball position, but this, as will be next seen, is unsatisfactory.

In Fig. 2 is shown the effective force acting horizontally on spring *A*, the upper solid curve being the force when the flyballs are out (quantity toward "off") and the lower solid curve the force when the flyballs are in (quantity toward "on"). Each curve is a parabolic curve, corresponding to the above equation for a particular value of *r*, and the difference between the curves depends on the design of the flyball leverage. Suppose the engine is running with a load at speed *A* and that this load is then entirely removed. The speed rises and the flyballs move outward, so that the new force and speed are shown by point *B*. The change in flyball position reduces the spring length. The shortened spring has an increased force equal to the increased effective force of the flyballs. The rate of the spring is the change in force between *A* and *B* divided by its corresponding change in length.

Assume next that the leverage about the pivots of the flyballs is so designed that the force curve in the outer position is actually less than in the inner position, as shown by the dashed curve. Raising the speed will increase the radial force as before, but the effective force at *C* remains unchanged. The flyballs will be able to stay anywhere between *A* and *C* without changing the force acting on the spring. A spring of zero rate would then be theoretically necessary to permit movement from *A* to *C*, but since such a spring is impossible, the speed would have to increase beyond *C* to increase the effective force and so move the quantity control toward the off position. Thus an unstable region exists between *A* and *C*. Because all springs have a finite rate, it is necessary to so design the flyball leverage that the force acting on the spring increases as the flyballs move outward.

The governor flyballs being thus designed to be stable, it is then necessary to select the proper rate of the spring to maintain stability. If the rate of the spring is increased, the speed will rise to some point *D* higher than *B*. The spring movement will be the same, but the force change will be greater by the vertical distance from *B* to *D*. The no-load speed

will be greater by the horizontal distance between these two points, and the regulation consequently not so close. Decreasing the rate will result in closer regulation until a limit is reached at the point *E* with no change in speed. Under this condition the governor may change the quantity from "off" to "full on" without any speed change, but this allows no control, and the quantity could vary even when it is supposed to remain constant. Hence, if zero regulation is approached, a condition of instability is reached. Every usable spring rate is therefore a compromise between stability and close regulation.

Instabilities due to either condition *A* to *C* or *A* to *E* show up in the engine as speed surges ("hunting," "rolling"). A slight instability often will not result in a surge until the load is suddenly changed. When the load is thrown off or on the engine, the result is something as shown in Fig. 3. Assume the engine is running at no load under governor control. When the load is thrown on, as when the clutch is let in or the generator switch is thrown in, etc., at 1, the speed quickly falls to 2, a temporary minimum called the "underrun." This momentary low speed is due to governor lag in increasing the fuel quantity. The flyballs have inertia in moving from their outer to their inner positions; once they are started they may move slightly too much in, giving more quantity than needed, and resulting in a slight rise at 3 above the

creasing the spring rate to 49 lb./in. increased the range of all the speeds and was, therefore, less satisfactory. Rates less than 34 lb./in. resulted in continuous surge and could not be used.

A spring which is satisfactory at one speed will have too low a rate at higher speeds and too high a rate at lower speeds. This is because the effective-force curves (Fig. 2) for the two extreme flyball positions converge as the speed falls. In other words, at

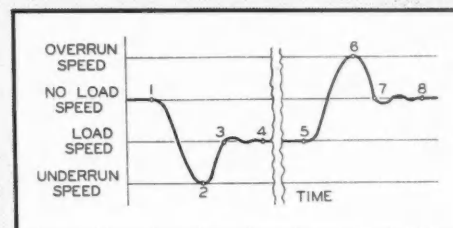


Fig. 3. Speed-Time Chart. Showing diagrammatically the four speeds resulting from rapid changes in load.

TABLE 1

Effect of Spring Rate on Governing

Spring Rate, lb./in.	34	37	49
Overrun.....	1280 r.p.m.	1235 r.p.m.	1300 r.p.m.
No Load.....	1200+	1220	1260
Full Load.....	1200	1200	1200
Underrun.....	1120	1200 (none)	1160

load speed. The speed may rise and fall below the load speed until reaching equilibrium at 4, but unless the governor is stable, this surge will not damp out. Suddenly removing the load also tends to initiate surge. When this is done, as at 5, a momentary "overrun" at 6 is reached, and equilibrium is finally attained at 8 at the no-load speed, if no instability is present. A very slight tendency to surge might result in between 3 and 4 only, and not between 7 and 8, or vice versa, depending on the design.

Table 1 shows the effect of the spring rate on these four speeds in actual engine tests in which the rated engine load was thrown on and off by operating the dynamometer switch. Operation in all three cases was stable.

The full load in each case was set at 1200 r.p.m. Note that with the lowest-rate spring the regulation was too close to be read on the tachometer used. This exceptionally close regulation resulted in more over and underrun than that with the 37 lb./in. spring. With the latter spring there was no observable underrun, and the no-load full-load regulation was 1.65 per cent—still excellent for a simple centrifugal governor. In-

any lower speed the change in effective force will be less, but the required travel approximately the same, so that a lower-rate spring should be used. If a spring of the same rate is used, then the change in speed will be greater. This is shown in Table 2, in which one spring was used in governing tests at two different operating speeds.

The lower force of the flyballs in the lower speed range reduced the overrun to zero and the underrun to 10 r.p.m., but increased the regulation from $\frac{1}{2}$ per cent to 22 per cent. The general effect of reduced speed is similar to increasing the spring rate. Table 3 shows the regulation at three different operating speeds for full load and no load, over and underruns not being recorded.

Table 4 shows regulation and also over and underruns at three operating speeds.

To get closer regulation over the speed range, more than one spring may be used. In Fig. 1 spring *A* might have a rate enabling it to be used without surge up to a certain speed, above which speed spring *B* is also brought into action. Since the combined rate of both springs is greater than the rate of *A* alone, higher speeds may be attained without instability.

TABLE 2

Effect of Operating Speed on Governing

	r.p.m.	r.p.m.
Overrun.....	2040	1250 (none)
No Load.....	2000	1250
Full Load.....	1990	1000
Underrun.....	1940	990
Regulation.....	10	250
Regulation, per cent. .	$\frac{1}{2}$	22

This practice merely divides the speed range into two steps, and the closest possible regulation is obtained only at two speeds. To cover the speed range continuously with closest regulation would require a spring whose effective rate was continuously variable. In Fig. 1 this could be achieved by using only spring A and sliding it up on the arm for low speeds and down the arm for high speeds, at the same time changing its length. Thus both the rate and the force of the spring, as effective at the spool, may be made to increase with speed, matching the curves of Fig. 2 and giving the closest possible regulation at all speeds.

Fig. 4 shows results of a bench test of the relative regulations of several springs of different rates over a wide range of speeds. This test was not run on an engine, but instead an arbitrary quantity-control movement which varied the delivery period of the pump *O* to 7½ deg. was used. By so running the test, the effects of pump and engine characteristics over the speed range are eliminated, and the characteristics of the governor alone are seen. The almost straight lines are those of constant "per cent" regulation. The test clearly shows how decreasing the speed of the governor requires a decrease in spring rate to maintain the same regulation. Since this test is really the effect on regulation between two positions of the fly-

TABLE 3

	r.p.m.	r.p.m.	r.p.m.
No Load	1475	1760	1855
Full Load	1200	1600	1800
Regulation	275	160	55
Regulation, per cent	20.6	9.5	3.0

balls rather than between two loads, it would be necessary to make a final selection of the springs in actual engine tests. If, however, the quantity-control positions, and hence the flyball positions, are the same for "no load" and "full load" over the engine's speed range, then the results are directly comparable.

With a constant effective spring rate the force change between the two positions of controls in Fig. 4 should be the same at all speeds. This means the difference between the square of the speeds of the two positions should be constant for all speeds. From this may be deduced the relationship

$$\frac{B_1 \sqrt{R_1}}{200 - R_1} = \frac{B_2 \sqrt{R_2}}{200 - R_2}$$

in which *B*₁ and *B*₂ are the speeds corresponding to full load and *R*₁ and *R*₂ the respective "per cent" regulations at these speeds. Applying this relationship to Fig. 4 shows that the effective spring rate was not constant. With a 32 lb./in. spring the

TABLE 4

	r.p.m.	r.p.m.	r.p.m.
Overrun	1230	1625	2080
No Load	1210	1600	2050
Full Load	910	1450	1990
Underrun	910 (none)	1450 (none)	1980
Regulation	300	150	60
Regulation, per cent	28.3	9.8	3.0

following values may be read from the figure:

$B_1 = 600 \text{ r.p.m.}$
 $B_2 = 740 \text{ r.p.m.}$

$R_1 = 12 \text{ per cent}$
 $R_2 = 4 \text{ per cent}$

Substituting only the values of *B*₁, *B*₂, and *R*₂, the above relationship gives a value of *R*₁ of 6 per cent, or twice as close as the observed 12 per cent, which was obtained because the effective spring rate was higher at 600 r.p.m. than at 740 r.p.m. Inspection of the spring suspension design of the governor tested, Fig. 5, shows that as the tension on the high-speed spring is increased by turning the speed-control arm clockwise, the effective lever arm is shortened. Hence the effective spring rate is decreased at higher speeds, and the difference between the square of the speeds is reduced.

Regulation depends on the relationship between the effective spring rate and the effective force of the flyballs. Hence both may be varied and the regulation remain unchanged if the relationship is the same. This is shown in Table 5 in which a high-rate spring with a set of heavy flyballs gave the same regulation as a low-rate spring with light flyballs.

There is thus some range of weight allowable in designing the governor.

Since it is not only the weight of the flyballs but actually their effective force that determines regulation, both their leverage and their radii are important factors. While centrifugal force varies directly as the radius, it is only the difference in force between load and no load that is of interest in governing. There-

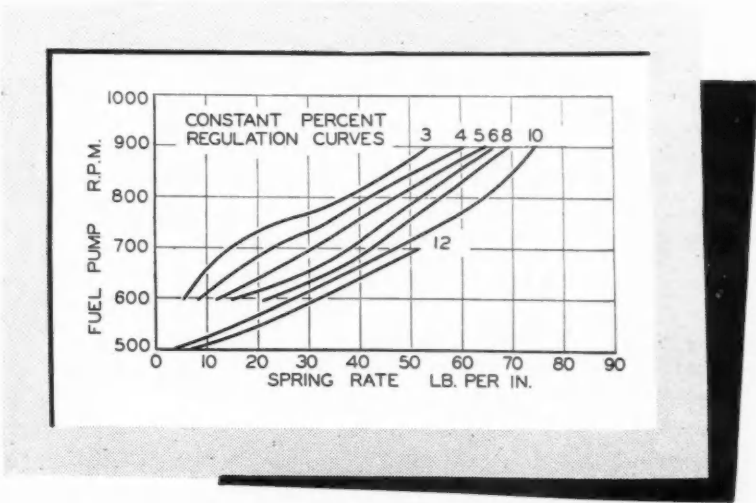


Fig. 4. Effect of Spring Rate on Regulation at Several Speeds. Showing results of a bench test.

fore, it is only the difference in radii of the flyballs that is important, provided the leverage is the same for all flyball positions. As mentioned in connection with Fig. 2, this is not always the case, and hence the difference in force may vary with flyball position. In such governors, to have uniformity of regulation in duplicate applications, it is necessary to use the same range of flyball positions, and provision is often made for an adjustment. This may be an adjustable-length member between the fuel pump and the governor, as in Fig. 5. The usefulness of such an adjustment is shown in Table 6.

The difference in effective force between no-load and full-load positions was greater, and the effective spring rate was probably less with the shorter link, both resulting in closer regulation.

The amount of effective force desirable in a governor will depend chiefly on the friction of the members moved by the force, experience having shown that friction should not be more than a certain percentage of the effective force. This apparent percentage, however, may be higher at high speeds, because vibration tends to reduce the friction. Regulation tests have shown that it is usually the over and underruns that are adversely affected by linkage friction, as shown in Table 7.

TABLE 5		
	Heavy Flyball 68 lb./in. Spring	Light Flyball 44 lb./in. Spring
No Load.....	1980 r.p.m.	2000 r.p.m.
Full Load.....	1950	1970
Regulation.....	30	30
Regulation, per cent..	1.5	1.5

In each case the equilibrium speeds at no load and full load were the same, since engine vibration finally overcame all resistance of friction to movement, but the governor lag was greater with friction and the momentary over and underruns were greater. Excessive friction will increase the lag so much that continuous surging results.

A dashpot is sometimes attached to a governor link-

TABLE 6		
	Long Link, Flyballs in Outer Range	Short Link, Flyballs in Inner Range
No Load.....	1300 r.p.m.	1220 r.p.m.
Full Load.....	1200	1200
Regulation.....	100	20
Regulation, per cent..	8	1.6

age to reduce surge, and if its resistance to motion is not too great, it may remove a surge originally due

to instability. A dashpot acts like friction in increasing the over and underruns, however, because it increases the lag of the governor. Table 8 gives results of a test in which a simple dashpot consisting of a piston in an air-filled cylinder was used, and its resistance increased by decreasing the piston clearance.

The effect of increasing the dashpot resistance is thus very similar to that of friction in the previous table, the regulation being only slightly affected, but the difference between the

over and underruns greatly increased as a result of lag. In this test the governor was stable and the dashpot was unnecessary.

Increasing the lag usually will also result in a greater number of surges before equilibrium is reached. Referring to Fig. 3, this means that there are more cycles of surge between points 3 and 4, and between points 7 and 8. In Fig. 6 the surges were counted for the different clearances of the dashpot and governor used in the preceding test. Surge was initiated, however, not by changing the load but by giving the governor linkage a sharp "kick," after which the number of cycles of surge to damp out was

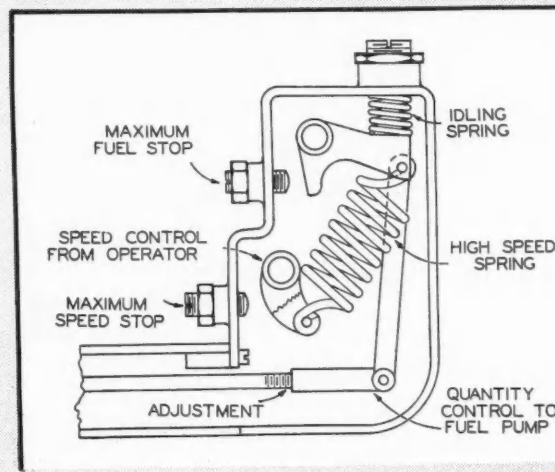


Fig. 5. Governor Used in Tests of Fig. 4. Increasing the tension of the high-speed spring decreases its lever arm.

TABLE 7		
	With Friction	Friction Reduced
Overrun.....	1280 r.p.m.	1235 r.p.m.
No Load.....	1220	1220
Full Load.....	1200	1200
Underrun.....	1120	1200 (none)
Regulation.....	20 r.p.m.	20 r.p.m.
Difference between Over and Underruns..	160 r.p.m.	35 r.p.m.

counted. When no dashpot was used the surge damped out in two cycles below 1000 r.p.m., shown by curve 1. At 1500 r.p.m. the governor was unstable, and surge never damped out, the spring giving good regulation at 1000 r.p.m. (Table 8) but having insufficient rate to be stable at 1500 r.p.m. When the dashpot with 0.0014 in. piston clearance was connected (curve 2), its resistance damped out the instability surge at 1500 r.p.m. in 12 cycles, but at 1000 r.p.m. it increased the number of cycles to damp out to 9. This was because at lower speeds the effective force was less, while the dashpot resistance tended to remain constant. With only 0.0007 in. clearance (curve 3), the resistance at low speeds was so great that the number of surges was more than at higher speeds, being a maximum of 30 cycles to damp out at 800 r.p.m. The resistance was sufficient, however, to damp out the instability surge at both 1500 to 2000 r.p.m. After these tests the dashpot cylinder was filled with S.A.E. 40 oil. This resulted in violent surge over the entire range of speeds above 1000 r.p.m.

A dashpot is thus of some use in enabling an unstable spring to be used satisfactorily if care is used in selecting its resistance. Its action differs from that of normal mechanical friction in having a zero static friction, although in motion both forms of resistance have the same effect. The dashpot with 0.014 in. clearance enabled a regulation of 25 r.p.m. to be obtained at both 1000 and 1500 r.p.m., a feat that otherwise

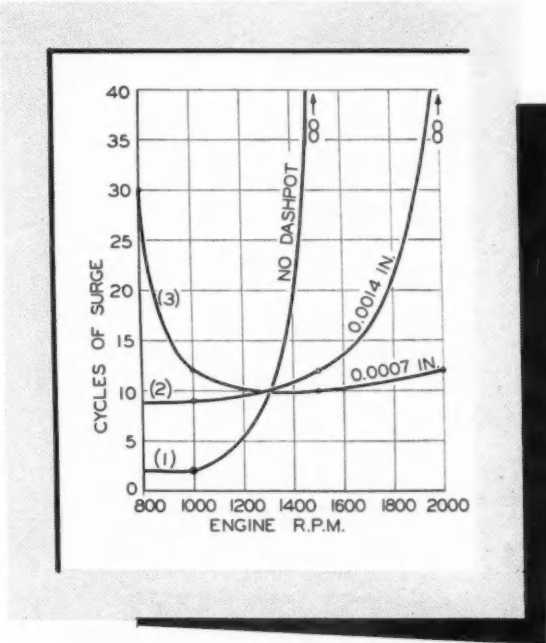


Fig. 6. Effect of Dashpot in Damping Out Surge. Increasing the resistance of the dashpot increases surges at low speeds and reduces them at high speeds.

TABLE 8

	Without Dashpot	Piston Cl. of .014 in.	Piston Cl. of .0007 in.
Overrun.....	1050 r.p.m.	1100 r.p.m.	1200 r.p.m.
No Load.....	1025	1025	1080
Full Load.....	1000	1000	1060
Underrun.....	980	990	1000
Regulation.....	25 r.p.m.	25 r.p.m.	20 r.p.m.
Difference between Over and Underruns....	70 r.p.m.	110 r.p.m.	200 r.p.m.

could not have been accomplished with one spring. In cases where such uniformity of regulation is needed over a speed range, the added complication of a dashpot may be worthwhile.

In all regulation tests up to this point the stop limiting the maximum amount of fuel was inoperative, i. e., it was set for a load greater than that used as full load in the tests. The purpose of this stop, indicated in Fig. 1, is to limit the travel of the quantity control so that more than the full load quantity of fuel cannot be injected. If the load at which regulation is being tested is as much as that for which the stop is set, full freedom of the governor is not obtained and regulation is not as close. The underrun will usually be greater, although the time to damp out the surges afterwards will be lessened, since overtravel of the flyballs into the "on" position will be prevented. Ideally, if the maximum fuel stop is set at 100 per cent load, it is inoperative at any lesser load, and regulation between any loads less than 100 per cent should not be affected. Actually, there is always

some vibration of the quantity control, and some flexing of the stop itself, so that the stop may have an effect on the fuel at several per cent under 100 per cent load. Table 9 shows the result of a governing test with and without the stop being set.

The speed was readjusted after setting the stop, as shown by the no-load speed. This was necessary to keep the full-load speed up in the range being tested. The interference of the stop with the governor at full load is plainly indicated by the wider regulation.

Fig. 7 shows more in detail a similar test of the same design of governor on quite a different engine. The solid line is the governing without a stop. One hundred per cent load was obtained at 915 r.p.m. and no-load at 950 r.p.m., giving a regulation of

$$200 \times \frac{950 - 915}{950 + 915} = 3\frac{3}{4} \text{ per cent}$$

With the stop set for this same full load, the result obtained is shown by the dashed curve. One hundred per cent load was obtained at 900 r.p.m. As the load was reduced, the speed rose and lessened the force of the quantity control against the stop, since this force was due to the difference between the spring force and the centrifugal force. This resulted in only a very

TABLE 9

	Without Maximum	With Maximum
	Fuel Stop	Fuel Stop
No Load.....	2050 r.p.m.	2125 r.p.m.
Full Load.....	1990	2000
Regulation.....	60 r.p.m.	125 r.p.m.
Regulation, per cent..	3	6

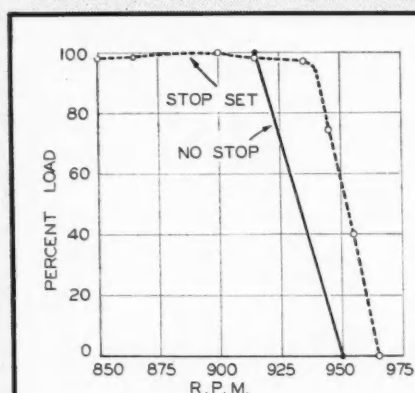


Fig. 7 Governing With and Without a Maximum Fuel Stop. When the stop was set for 100 per cent load, governing up to 95 per cent load was practically unaffected.

slight movement of the quantity control to the "off" position, and the speed increased considerably until about 940 r.p.m. was reached, when the control was

Spring Rate lb. in.	Minimum Steady Speed (speed D) 350 r.p.m.	Minimum Idling Speed (speed B) 340 r.p.m.
84	350	340
56	350	340
48	340	320
24	420	300

far enough away not to touch the stop at all. Above this speed the two curves are almost identical in slope, since the stop was not touching in either case. No-load speed was not reached, however, until 965 r.p.m., or a higher speed than when no stop was used. The spring was adjusted in both cases to give about the same speed at 95 per cent load. The regulation in this second case was

$$200 \times \frac{965 - 900}{965 + 900} = 7 \text{ per cent}$$

or almost twice as wide as when the maximum fuel stop was inoperative.

Below 900 r.p.m. the power curve (dashed) was a result of the quantity-speed characteristic of the injection system, the governor holding the quantity control tight against the top at all times. There can, of course, be no solid curve below this speed, since without the stop acting, the governor merely increases the

quantity into the overload range. Every Diesel is normally equipped with a maximum fuel stop to prevent such overloading, and to secure close regulation it is necessary to use a full load somewhat below that for which the stop is set. For example, if the stop in Fig. 7 is set at 100 per cent load, regulation up to 95 per cent load will not be impaired. This figure will depend entirely on the governor and the fuel pump used in the particular installation.

Since the effective force decreases as the square of the speed, it is usually the lowest operating speed that determines the minimum force necessary. With a given amount of friction it is usually the idling speed of the engine that determines the weight of the flyballs and hence the general weight and size of the whole governor. If the high-speed spring is operated directly by the hand or foot, the amount of force is limited. For these reasons it is generally desirable to use the least effective force necessary for satisfactory idling at low speeds. Fig. 8 illustrates what happens when using a governor to run a Diesel at no load at low speeds. Speed A is here defined as the engine stalling speed, below which the Diesel cannot run. This speed is considered to be purely an engine characteristic, determined by its flywheel, losses of compression, loss of heat from the walls of the combustion space, atomization of the fuel, etc. Since at these low speeds the inertia is small, the speed will fluctuate past top center; speed A is an average r.p.m. Suppose now the engine idles under governor control. A mean speed of B will be the minimum idling speed because the speed will drop periodically to A, due to frictional lag. Idling will be a series of surges or "rolls," the period of which is usually much longer than that of high-speed surge, about mean speed B. When the speed is raised to C or D, it is steadier, because the effective force is greater and the lag less. The amount of this roll depends not only on the governor but also on the engine itself, since it is the inherent instability of the latter that the governor has to "balance." At speed D the effect of a higher-rate idling spring will usually be to reduce the amplitude of this roll by reducing the

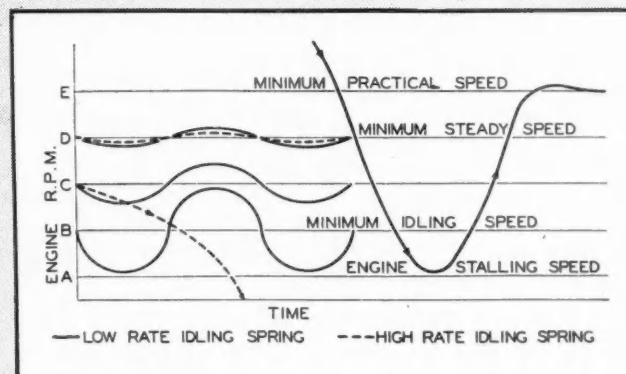


Fig. 8. Idling Speed-Time Chart. The "roll" is usually not as symmetrical or uniform as indicated in this sketch.

overtravel of the quantity control, but at speed *C* this spring will allow the engine to stall, since the higher-rate spring requires a greater range of speed to give the same movement of the quantity control. If the speed has to fall below *A* before the quantity control moves sufficiently to raise it, the engine stalls. For this reason there is usually less danger of stalling when a spring is used whose rate is low enough to give a certain amount of roll, or at least a certain amount of fluctuation in speed whether of uniform period or not. Stalling is most likely to occur when the speed is suddenly "cut" from a very high value, since during the coasting time of the engine the quantity control is in the "fully-off" position, and the stalling speed is almost reached before the control again increases the quantity. Hence a still higher speed *E* is necessary as a "minimum practical speed." In Fig. 8 the curve originating at a high speed represents the condition of a rapidly falling speed which almost reaches the stalling speed *A* but recovers and steadies at *E*.

Table 10 shows the effect of the spring rate on idling speeds.

Speed *D* was an arbitrary speed at which the amount of roll was considered unnoticeable, but actually it was a mean speed, as was speed *B*. Note that the lowest-rate spring gave the highest steady speed but the lowest minimum idling speed. It was least liable to stall but gave the most roll. The best spring was the 48 lb./in. one, since this gave the lowest steady speed.

In another test with a governor of far less effective force there was also an optimum rate for minimum steady speed, shown in Table 11.

TABLE 11

Spring Rate lb./in.	Minimum Steady Speed (speed <i>D</i>)
4½	300 r.p.m.
3½	250
2	325

Thus the rate giving the steadiest idling will be one of medium value. In a later test with the 3½ lb./in. spring some friction was put in the linkage, and the minimum steady speed went to 375 r.p.m.

Since the rate-of-spring for idling is important, it is customary to use a different spring for idling than is used for high-speed regulation. Some installations are insensitive to the idling spring rate, however, in which case one spring may be used for both idling and high-speed regulation with good results. In one application a minimum practical speed *E* of only 300 r.p.m. and a regulation of 40 r.p.m. from no load to full at 2400 r.p.m. without surge was obtained with a single spring.

The weight of the flyballs is important at idling

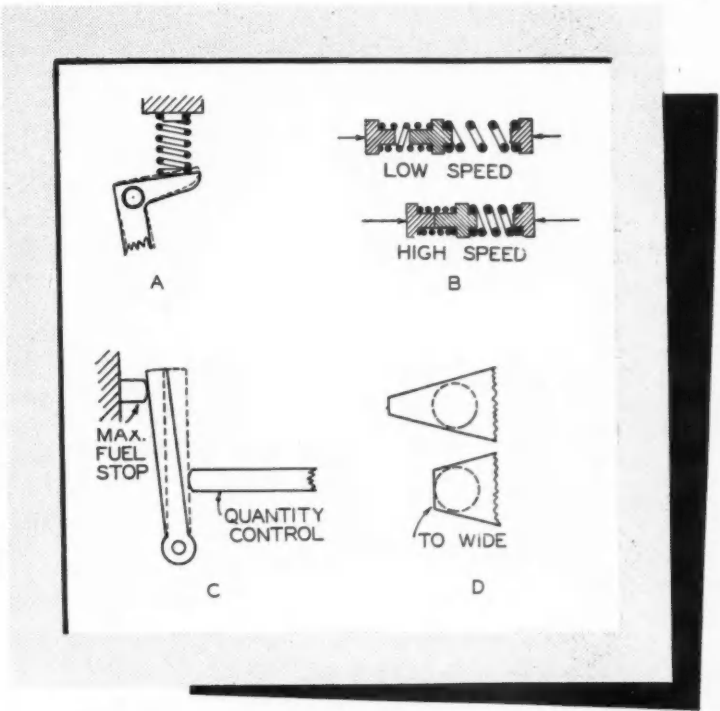


Fig. 9. Examples of Designs Causing Surge. *A* and *B* show faults in governor-spring suspension, *C* and *D* in fuel-injection-pump design.

speeds, heavier weight invariably giving better idling. In Table 12 two different weight flyballs, with their most suitable springs, are compared.

The heavier flyballs with their corresponding spring gave more effective force to overcome linkage friction, and lag and roll were reduced, resulting in lower idling speeds.

The minimum practical speed is usually raised by a dashpot, which increases the lag. Another factor increasing lag is excessive clearance in the pins of the linkage, so that the flyballs move before the quantity control is affected. On the other hand, decreasing the clearance too much will increase the friction and again increase the lag, so that a compromise is necessary. One design takes care of this by using excessive clearance and a light spring to take up the clearance to zero, an arrangement that has proved very satisfactory. The general rule in design and manufacture is to avoid any sudden changes in either the movement or the force required, as with such sudden changes surge may result, particularly at low speeds. While friction is the chief offender of this rule, some other don'ts are shown in Fig. 9.

In Fig. 9 (*A*) the idling spring did not rest squarely at all times on the governor arm. When the arm was in the down position it touched only one side of the

TABLE 12

Flyball Weight	Spring Rate lb. in.	Minimum Idling Speed (speed <i>B</i>)	Minimum Practical Speed (speed <i>E</i>)
Heavy	84	250 r.p.m.	275 r.p.m.
Light	24	300	400

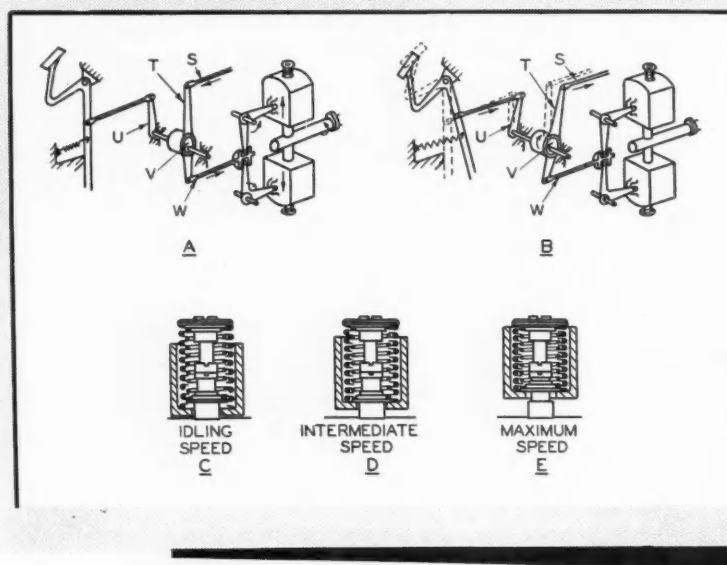


Fig. 10. Bosch Two-Speed Centrifugal Governor. This design governs at idling and maximum speeds only.

spring coil, while when the arm moved up it touched the entire end of the spring. The effective rate of the spring thus changed, and the rolling at idling was excessive. Changing the relative positions of the arm and the spring to secure contact over the entire spring end at all times removed the roll. A similar change in rate occurred in (B). In this case two springs were used; both being used for idling and all speeds up to 1400 r.p.m., and only the right-hand high-rate spring for higher speeds. With no load, a continuous surge occurred between 1100 and 1500 r.p.m., because in this range any momentary surge caused the left-hand spring to collapse and the combined rate of the two springs suddenly changed to that of the right spring. Using a single spring removed all this surge. In (C) the lever between the pump quantity control and the maximum-fuel stop vibrated at a critical engine speed when the stop was not set in its normal position. When set, the stop reduced the range of the lever movement enough so that all surge was eliminated, hence this was not a serious condition. However, when the stop was not set, a light rubber band was sufficient to hold the lever against the stop and also eliminate the surge. Vibration of this sort is usually detrimental only at quite high speeds, since at low speeds it reduces friction. In (D) the design of the slide valve injection pump caused idling surge. In one case (lower view) the tip of the land which mated the port was too wide, so that in idling the change in quantity was effected by changing the area between the end of the land and the port rather than the area at the sides of the land. This gave a sudden increase in quantity when the land moved to the left, since it covered the port all at once. Making the land narrower, as in the top view, removed the excessive idling surge.

With vehicle engines the governing problems are somewhat different than in stationary installations. Very close regulation is not necessary, although it is an advantage at the maximum speed, as has been men-

tioned. Idling is usually more difficult, because of the lighter flywheels used. The operator is constantly changing the speed with his foot, and, therefore, the force required to move the pedal is limited by his fatigue. The weight of the linkage is important, since when the brakes are applied the linkage will tend to move forward. If this forward motion is toward the "off" position, the engine may stall when the brakes are suddenly applied. In this case, if the vehicle is idling on a down hill slope, it will idle at a lower speed and may also stall. In such designs it is necessary to have the effective force large compared with the weight of the linkage. A better design is to have only a vertical linkage motion. Sometimes a neutralizing weight is added so that neither momentum nor gravity will have any effect, but this

usually increases the friction.

Using a greater effective force without affecting the pedal reaction is accomplished with the linkage system shown in Fig. 10. This linkage permits the governor to control the idling and maximum speeds only, intermediate speeds being controlled directly by the operator. Two springs are always used, the maximum speed spring being preloaded to "collapse" at the desired top speed. The outer spring only is active in idling, as in (C), the linkage relationship then being as in (A).

Pedal-controlled arm (U) is held to the left by the light pedal-return spring, and the flyballs work against the outer, idling spring and move quantity control (S) through lever (T). The resulting action is identical in principle with that of Fig 1, when spring (A) is used. When the pedal is depressed, the motion of lever (U), as in (B), to the right turns eccentric (V) inside lever (T), moving the latter also to the right, and moving quantity control (S) to the "on" position. The speed then rises above the idling speed, and the flyballs move out against the preloaded maximum speed spring, as in (D). As long as maximum speed is not approached there is no further movement of the flyballs, and hence no governor action. Fulcrum (W) remains fixed, and quantity control (S) is moved directly by the pedal as though no governor existed.

When the maximum speed is reached, the force of the flyballs equals that of the preloaded spring plus that of the compressed idling spring, and both springs further compress, as in (E). Linkage movement again takes place as previously, lever (T) moving about fulcrum (V) and moving quantity control (S). There is always a limiting stop for the pedal travel, so that the governor travel will always be sufficient to shut off the fuel. There is also a maximum fuel stop to limit the travel of control (S). The screw adjusting the compression of the outer spring corresponds to that compressing spring A in Fig. 1, since this determines the idling speed. The maximum speed adjustment is

the screw determining the preload on the inner spring; this corresponds to the adjustable stop for the member compressing spring *B* in the design of Fig. 1. All remarks pertaining to regulation, surge, friction, lag, etc., apply to this type of linkage as well as to the variable-speed type.

One of the most difficult practical problems in Diesel governor applications is the governor drive. This is due to the fact that governors are susceptible to torque fluctuations because of their relatively large flywheel effect compared to their lighter driving parts. Many shafts on Diesel engines used for governor take offs, especially fuel pump shafts, have large torsional fluctuations in speed. Care must be used in selecting such points for governor drives, especially if the governor is to be geared up to save weight. Very light gears are usually satisfactory if the drive is at the engine end of the fuel pump, but they often fail if at the free

end of the fuel pump, where torsionals are worse. It is usual in the latter case to eliminate the gearing and use a heavy, direct drive. Even with such a direct drive some manufacturers use an overrunning clutch between governor shaft and fuel pump shaft, so that whenever the latter rotates slower than the governor, the clutch disengages. This avoids both the rapid deceleration and rapid acceleration otherwise resulting from torsional vibration, and reduces the strain in the shaft, flyball bearings, and similar rotating parts apt to fail.

Acknowledgments

The author wishes to express his appreciation for permission to publish results from tests made in the laboratories of several companies in the Diesel business, including The Buda Co., Harvey, Ill., Ex-Cell-O Corp., Detroit, Mich., and Hercules Motor Corp., Canton, Ohio.

Westad Fuel Economizer

The general idea of opening the cylinders of an automobile engine directly to the atmosphere during periods when the car is coasting is quite old, but the French Westinghouse Brake Company (Freinage Westinghouse, Freinville-Sevrans, S.-et-O.) has developed a new device which it calls the "Westad," by means of which it is possible to shut off the carburetor and to open the cylinders directly to the atmosphere under coasting conditions. It prevents all fuel consumption not only while the car is descending grades, but also while it is being brought to a stop by means of the brakes. Ordinarily when he applies the brakes, the driver releases the accelerator, thereby closing the throttle. This places the carburetor in the "idling"

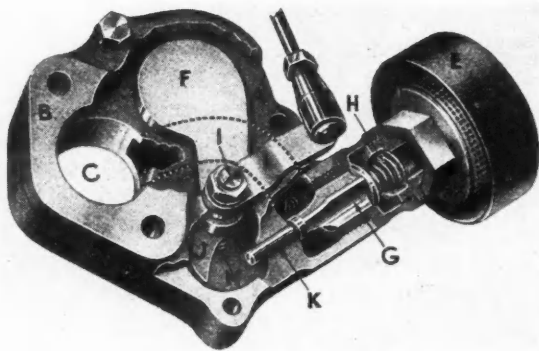
into the combustion chamber, which usually results in a smoky exhaust on the next pick-up.

A sectioned view of the Westad is shown herewith. It is installed in the induction line between the carburetor and the inlet manifold. The device consists of a body *A* and cover *B*. Within the body *A* there are two passages, passage *C* being intended for combustible mixture and passage *D* for fresh air, which is taken in through air cleaner *E*. Each of the two passages can be closed, the former by shutter *F* and the latter by poppet valve *G*, which is held to its seat by spring *H*. Shutter *F* and valve *G* are interconnected in such a way that as the shutter is closed the valve is opened, and vice versa. Shaft *I* of the shutter is provided with a finger *J* which at the moment when the shutter approaches the closed position, raises valve *G* through the intermediary of tappet *K*. Shaft *I* is operated by means of lever *L* which is connected by a link to the accelerator pedal. Air-tightness between shaft *I* and cover *B* is ensured by a conical collar subjected to pressure by spring *M*.

When passage *C* is closed the engine cannot exert any suction on the carburetor, and there is then no consumption of fuel.

Four-cylinder Operation of V-8

In Great Britain, owners of Ford V-8, and of eight-cylinder cars generally, now are being offered the opportunity to save on their annual tax and on their fuel costs by having four of the eight-cylinders rendered inoperative. Since the recent increase in the horsepower tax, the amount levied on a Ford V-8 amounts to £37 10s annually. With only four cylinders operating (two in each block) the car, of course, will have less acceleration and less maximum speed, but it is said to still travel quite comfortably at 45-50 m.p.h. The cost of the conversion is £12, and the sponsors of the conversion scheme—who attend to the registration formalities—figure that the combined savings on tax and fuel during the first year will amount to £14.



Westad Fuel Economizer.

position, and owing to the initial high speed of the engine, a very high suction is produced in the manifold beyond the closed throttle, and a heavy charge of fuel is drawn in through the idling nozzle. This, it is explained, is a complete waste, since no power is required. The rich mixture drawn in results in incomplete combustion and carbon deposits in the combustion chamber. Moreover, the resulting high vacuum in the cylinder draws considerable oil past the piston

Automotive MATERIALS

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Aluminum Alloy With Tensile Strength Up To 33,000 lb.

T-1 aluminum alloy is a new product offered by the National Bronze & Aluminum Foundry Co., Cleveland, Ohio. The material, without heat treatment or any artificial means to enhance its physical properties, has the following characteristics: ultimate strength, 30,000 to 33,000 lb. per sq. in.; yield strength 16,000 to 25,000 lb. per sq. in.; elongation, per cent in two inches, 6 to 10 per cent; Brinell hardness, 60-78; reduction of area, 8 to 10½ per cent; Charpy impact, 2.19 ft.-lb.; modulus of elasticity, 10,300,000 lb.; specific gravity, 2.78; weight per cu. in., 0.1003 lb. Bend tests show 21 to 23 deg. before fracture when test bar is bent around bar of diameter equal to thickness of specimen.

The composition of the T-1 alloy is copper, 1.50 min.-2.25 max.; Tin, 1.25-1.75; Magnesium, 0.50-1.00; Zinc, 0.50-1.25; Titanium, 0.10-0.25; Chromium, 0.15-0.30; Aluminum, balance. The producer points out that the aluminum used in T-1 alloy is 99 per cent plus virgin aluminum.

Among the desirable characteristics claimed for T-1 is high corrosion resistance. In fact, the alloy was revealed under test to have approximately the same resistance to salt water corrosion as Navy Alloy 46 Ale-4. Castings of T-1 are said to be superior to heat treated castings because the latter must be heated and quenched to produce the properties desired. The quench

sets up severe internal stresses which often make themselves apparent in warpage of the casting. Even when warpage does not occur, these stresses are present and can cause failure of the castings under service conditions. No quench is used in the case of T-1 castings, producing castings that are free from internal stresses and strains. Another advantage advanced by the manufacturer is that sheet, tubing and castings can be welded on T-1 castings without in any way destroying the physical properties of the alloy.

Vat Dyes May Improve Automotive Finishes

Tests indicating the possible application of vat dyes in automotive finishes were reported before the American Chemical Society by Crayton K. Black, Du Pont Co. chemist at the Cincinnati meeting of the organization held last month.

"The need for colors of greater light resistance has been intensified by advent of the so-called metallic finishes," Dr. Black stated. "In this type, aluminum powder replaces a portion of the pigment so that a tinting effect is obtained. Many colors with adequate light fastness in full shades do not retain them under these conditions. Automobile stylists have been greatly handicapped because of inability to secure light-fast shades of the desired hue."

Dr. Black cited a number of tests which he said indicated possibilities in the use of vat dyes to fill these requirements. A vat blue was ground into a nitrocellulose lacquer and painted on automobile body steel panels. Comparisons after 10 months' exposure in Florida showed "very little" change, while other blues either turned green or faded completely.

New Developments in

Automotive

Another set of panels contrasting a "thioindigo" dye with the azo maroon pigments in use was displayed. In this instance a metallic finish was used, and exposed for 12 months. The thioindigo dye was shown to have experienced far less color change than other maroons, and exhibited no bronzing under buffing, an important property of a maroon.

"Despite a relatively high pigment cost," Dr. Black concluded, "vat dyes may prove an economical solution, particularly in the case of pale tints where only a small quantity of vat color is required."

Light-Weight, Rust-Proof Alloy of High Strength

The Colonial Alloys Co., Philadelphia, Pa., is offering a new light-weight, rust-proof alloy of high strength. Known as No. 301 Alloy, its characteristics as recorded by a Tinius Olsen testing machine are as follows: ultimate tensile, 72,110 lb. per sq. in.; elongation, per cent in 2 in., 32; yield point, 57,530 lb. per sq. in.; reduction of area (per cent of original section), 76.5; Brinell, 109.

This alloy is said to have good forming and drawing qualities and to be absolutely rust-proof. It is approximately 66 per cent lighter than steel or iron and 70 per cent lighter than brass, copper, nickel or bronze. Thermal and electrical conductivity factors are good, as well as the corrosion resistance.

No. 301 lends itself to gas welding, spot welding, seam welding, arc welding, brazing, soldering, "Colawelding" (fusion welding chemically) and reaction soldering. It may be polished to a lustrous, silvery, chrome-like appearance; also, it is non-magnetic and non-sparking. Colonial Alloys Co. can furnish this alloy in sheet, plate, rod, bar, wire, pipe, tubing, extruded forms in a wide range of gages and sizes.

New Enamel Designed For Coloring Plastic Parts

Recently developed by chemists of the Sherwin-Williams Co., Cleveland, a new enamel makes it possible to coat cheap black plastic material with attrac-

tive iridescent colors. The new finish, called Kem Bakolescent in the iridescent form and Kem Plastite in solid colors, can be dipped or sprayed on plastic parts and combines any color with long-wearing surface.

Special Enamels For Infra-Red Baking

Enamels which are especially designed for high speed baking schedules in infra-red lamp (radiant heat) ovens are offered by Maas & Waldstein Co., Newark, N. J., in two new lines. Known as "Raydur" synthetic baking enamels and "Raydur" Duart wrinkle elements, both will bake to a hard, durable surface in 15 to 20 minutes and can be handled for assembly half an hour later with little danger of marring. M & W claims that color retention is good, and the adhesion on various metals and molded Bakelite is excellent.

The baking enamel can be supplied in high gloss and semi-gloss finishes, and the wrinkle enamel can be supplied in grades to form fine, medium and coarse patterns. Both are available in black, white and most colors.

Extruded Tubing Has Unusual Properties

Extruded tubing manufactured in continuous lengths and having characteristics of importance for its use in many industries is an interesting new development achieved with plastic materials.

Among its specific characteristics are the following: excellent flexibility at all temperatures down to minus 4 deg. Fahr.; extreme flexibility which permits bending the tubing on itself with wire inside without cracking, and returning to its original form after cutting, flexing or stretching; great resistance to tear and abrasion, yet easily cut into desired lengths; high tensile strength, equal to 2150 lb. per sq. in. for No. 8 tubing; improved heat resistance without losing form up to 300 deg. Fahr. and not affected at soldering tem-

Materials

peratures; fire resistant when tested in accordance with A.S.T.M. specification D350-39T; oil resistance sufficient to remain intact and smooth when heated for 48 hours at 220 deg. Fahr. in Wemco or other transformer oil; resistant to most coal tar solvents, denatured alcohol, petroleum solvents including gasoline, and acids and alkalies in concentrations up to 30 per cent by weight; dielectric strength dry, 750 volts per mil up to 0.022 in. and wet, 350 volts per mil up to 0.022 in.

The new product is produced in five standard colors from size No. 20 up to $\frac{5}{8}$ in., but can be manufactured in different sizes and wall thicknesses. It is known as Irv-o-lite Type XTE-30 and is manufactured by the Irvington Varnish & Insulator Co., Irvington, N. J.

A New Group Of Water-Soluble Vinyl Resins

Many uses in the automotive and aeronautic industries are anticipated for a group of water-soluble vinyl resins introduced recently by E. I. du Pont de Nemours & Co. The resins, which may be molded, extruded or cast into sheets, are described as polyvinyl alcohols and have been designated as PVA. Their properties also suggest many possible applications in other industrial fields.

Molded articles, such as sheets, gaskets, diaphragms, washers and tubing, are characterized by elasticity, toughness, flexibility and heat resistance. They have an inherent resistance to the action of oils, fats and most organic solvents. The material also resists the action of oxygen, ozone and deterioration caused by vibration or flexing.

PVA compositions are extruded in the form of tubes, rods, sheets and threads. Tubing and hose are now available commercially. The plain, unpigmented tubing is transparent and almost colorless. It is impervious to oils and solvents, and is unusually resistant to flexing and vibration. Further, it has low specific gravity, high tensile strength and high abrasion resistance at low temperatures.

A number of polyvinyl alcohols are available. They are white to creamy white powders, odorless and tasteless, with low apparent density. They are of value as emulsifying and thickening agents in water solution, and a high film-forming power makes them useful for coating and coloring various materials. These films are formed from water solution, avoiding need for the use of flammable or toxic solvents. They may be made quite resistant to water.

The physical and chemical properties of these compounds and the various methods of use are discussed in a technical bulletin prepared by the R. & H. Chemicals Dept., E. I. du Pont de Nemours & Co., Inc.

Durez Adds To 1900 Black Series Of Phenolic Molding Compounds

Durez 1905 Black has been added to the 1900 Black series of phenolic molding compounds manufactured by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. This material has an impact strength of 0.6 (A.S.T.M.) and heat resistance of 418 deg. Fahr. Unusually good gloss for high-impact compounds is claimed.

Durez 1905 Black is available only in a new particle size especially designed for free flowing through feeders and hoppers to simplify the production of preforms. Due to the high bulk factor of the 1900 series, deeper preform cavities are required; otherwise, thin preforms will result.

Pulley Covering To Prevent Belt Slippage

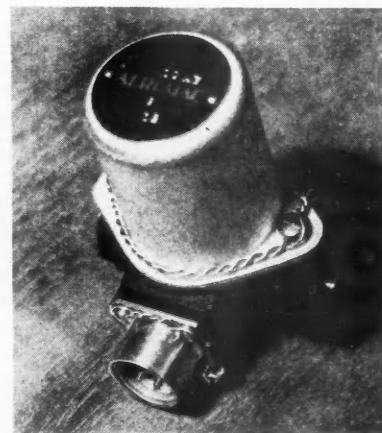
A material which was invented some 40 years ago and applied to the face of pulleys to prevent belt slippage now is being manufactured on a commercial scale. Up to the present the inventor has made it to order only for a few customers. The product is called Nonslip Pulley Covering and is supplied in sheets containing 9 sq. ft. of the material. Nonslip Pulley Covering is manufactured by the Nonslip Pulley Covering Co., Buffalo, N. Y.

Solenoid-Operated Oil Dilution Valve

The valve illustrated herewith has been developed by the Aeronautical Manufacturing Corporation, Buffalo, N. Y., for use in oil-dilution systems when gasoline or other fluids are used to dilute the engine lubricating oil in order to assist in cold-weather starting. When the operator wishes to dilute the oil, he closes an electric switch, and as long as the current is applied, the valve remains open. Actuation is by means of an electric solenoid, the valve being closed by a spring. While the average fuel system of both aircraft and industrial powerplants operates at a comparatively low pressure, this valve was designed to be pressure-tight even under high test pressures.

While this particular valve was primarily designed for use on aircraft, it is suitable for operation in automotive and industrial applications wherever a valve of this type is required and it can obviously be furnished wound for both A. C. and D. C. voltages.

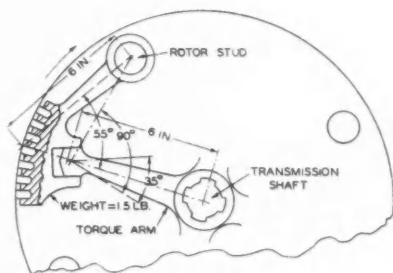
Solenoid-operated oil dilution valve developed by the Aeronautical Mfg. Corp.



Weiss Hydrodynamic Transmission Improved

IN AUTOMOTIVE INDUSTRIES of March 13, 1937, we illustrated and described a hydrodynamic transmission invented by Carl W. Weiss of Brooklyn, N. Y. This transmission has undergone a number of developments, and the latest design is shown in longitudinal section herewith. While the general principles remain the same, the design differs considerably in detail, and a reverse gear of the planetary type has been substituted for the sliding pinion type.

Referring to the sectional drawing, the sealed hy-



Details of the centrifugal clutch.

draulic unit consists of a casing A bolted to the crankshaft flange, a casinghead V, an impeller E, a rotor G, and a reaction rotor H with sun-gear sleeve H¹.

Fulcrumed on bearing studs projecting from rotor G are centrifugal-clutch weights D which have sliding connection with torque arms C, the hub of which is splined to transmission shaft B. At a given angular speed of rotor G the centrifugal force on weights D will hold in balance a given torque load on arms C. Should the speed of rotor G increase or the torque on arms C decrease, the weights D will tend to move outward, and vice versa. An outward movement of weights D engages the clutch, while an inward movement disengages it. Engagement and disengagement of the clutch therefore depend always upon the driving impulse against the load. The weight necessary for a direct-acting clutch is determined by the force required for engagement—

$$W V^2$$

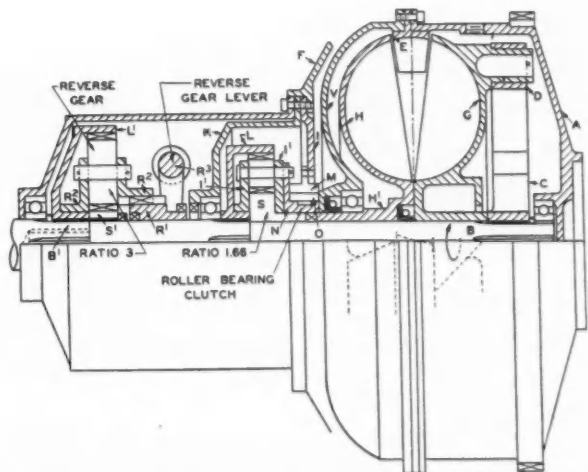
$$F = \frac{W V^2}{G R} \times \text{tangent of contact angle between D and C.}$$

$$G R$$

Assume clockwise rotation of the impeller (looked at from the engine end). The impulse of the driving fluid against rotor blades G is stepped up by counter-clockwise rotation of reaction rotor H, due to the impact on it of fluid from rotor blades G. Counter-clockwise rotation of H and sun gear S—the planetary gear carrier I² being locked to transmission housing F by the roller-bearing clutch M, N, O—causes internal gear L, splined to transmission shaft B, to rotate clockwise. The torque thus impressed on transmission shaft B by the gear ratio of the reaction rotor is added to the direct torque of the liquid-velocity impulse on rotor G. It has been found that the starting torque (as when

starting a car from rest) is considerably higher than would be expected from the torque-step-up gear ratio. The ratio of the gear shown in the drawing is $1.66 + 1 = 2.66$, while the actual starting torque ratio is 4:1 at normal engine speed. The excess torque depends on the speed of the engine when rotor G and reaction rotor H are not rotating and the power input to maintain the velocity in the fluid circuit is restored to the impeller due to the curvature of the blades. It is therefore possible to speed the engine immediately to produce the maximum fluid-velocity impulse on the blades of both rotors during acceleration. As the car speed increases, the velocity difference between the liquid circuit and the rotor decreases and the impeller takes full load. Then, since the centrifugal force of the clutch weights increases with the square of the velocity, direct-drive engagement follows, and the hydraulic unit and transmission shaft B rotate at crankshaft speed. There is said to be no appreciable reaction (shock) due to the small velocity difference between the clutch weights and casing A during engagement or disengagement of the clutch.

A reverse gear of the conventional gear-cluster type may be secured to the transmission housing. The planetary gear shown has an internal gear L¹ splined to a stub shaft B¹ in which the pilot of shaft B has a bearing. A sun gear S¹ is splined to shaft B. Pinion carrier R² engages the free-floating member R¹, which is controlled by the forked lever R³. In the position shown, R¹ is in neutral and shaft B cannot transmit motion to shaft B¹. The universal joint and propeller shaft are not shown. When R¹ is shifted to the left, it engages with sun gear S¹ and motion is transmitted from shaft B to B¹. When shifted to the right, R¹ engages member K, which is secured to transmission housing F. Pinion carrier R² is then held stationary and internal gear L¹ with shaft B¹ reverses the direction of rotation of shaft B.



Longitudinal section of the Weiss hydrodynamic transmission.

Discussion of

"A Mathematical Consideration

EDITOR, *Automotive Industries*:

Mr. Heldt deserves the gratitude of the automotive fraternity for his effort to blow some of the smoke screen away from the hydraulic coupling. He has certainly condensed the subject to its barest essentials.

In dealing with liquid flow in a path so complex as that in the fluid coupling, the concept of the angular momentum of the fluid with respect to the rotor axis offers a simple means of analysis. (For the sake of the record, the justification for Mr. Heldt's calculation of r_1 and r_2 really belongs to angular momentum rather than to kinetic energy. The result is unaffected by the change in reasoning, since angular momentum and kinetic energy are dimensionally similar.)

The recognition of the change in angular momentum of the fluid during its passage through the rotors leads to an expression for the torque whose value is double that which Mr. Heldt derives. His principle that "the force of the reaction between the stream and the surface (of the runner vane) is equal to the product of the mass of fluid striking the surface by the change in velocity imparted to the fluid" is entirely valid and, in the case of rectilinear motion of the surface, easily applied. Stated in other words, the impulse on the vane is equal to the decrease in momentum of the liquid.

The turbine runner utilizes this reduction in momentum more effectively than the above statement implies, for it receives the liquid flowing with high momentum at the outer radius r_4 and rejects it with low momentum at the inner radius r_3 . The determining factor in the torque acting on the runner is the change in the *moment* of momentum experienced by the working fluid rather than the change in the momentum itself. So the assumption that the force is applied to the vanes at the mean radius $\frac{r_4 + r_3}{2}$ seems illogical.

The fluid torque acting on the turbine runner, based on the reduction of angular momentum then is equal to

$$T = \frac{WN(r_4^2 - r_3^2)}{44225} \text{ lb. ft.}$$

if we neglect the slip in speed between the impeller and the runner. ✓

Mr. Heldt's elimination of the inner walls of the fluid passage about the annulus in the rotors is open to question, if the change was made for the purpose

of improving the flow of the liquid. The channel shown in the accompanying Fig. 1 with its mechanical boundaries agrees with general practice and helps visualize the fluid path.

In analyzing the fluid coupling, the characteristics of the liquid flow about its annular channel between the vanes is of prime importance. As Mr. Heldt shows, the rate of circulation of the fluid determines the torque that can be transmitted from the impeller to the runner. But why, and in what quantity does the fluid circulate?

Referring to Fig. 1, the flow of the working liquid about its vortex path is caused by the unbalance between the centrifugal force of the liquid in the impeller rotating at n r.p.m. and the centrifugal force of the

liquid in the runner rotating at N r.p.m. The greater the differences between these two forces, the greater will be the tendency for the liquid to circulate.

This flow is opposed by the fluid friction. Mr. Heldt assumes the flow to be approximately streamline in character, but that is hard to accept in view of the small disturbance necessary to cause turbulence even in a straight, smooth channel. Conservative design seems to favor the acceptance of turbulent flow under all operating conditions.

A detailed analysis of the forces that act on the fluid in the pump impeller (see Fig. 2) shows that the centrifugal force induces a unit pressure over the outlet area A equal to approximately

$$F_p = 0.0000142\rho(r_4^2 - r_3^2)n^2$$

lb. per sq. in. where ρ represents the fluid density in lb. per cu. in. The opposing centrifugal force Ft in

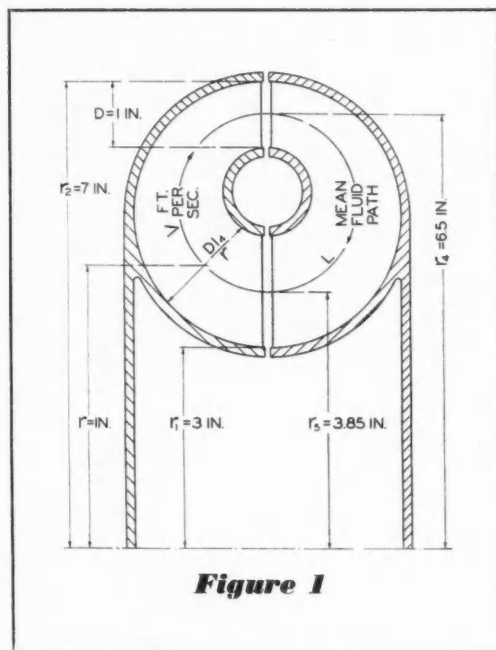


Figure 1

of the Fluid Coupling"

An article by P. M. Heldt which appeared in the April 15, 1940 issue of Automotive Industries

the turbine runner is identical with F_p except for the transition to the speed N . The resultant unit force causing the liquid to flow from the impeller to the runner, expressed in terms of fluid head is therefore

$$H = 0.0000142(r_4^2 - r_s^2)(n^2 - N^2) \text{ inches.}$$

This head is expended in forcing the liquid through a rectangular passage roughly equivalent in area to D in. on a side, around a circuit L in. long at a velocity of V ft. per sec. against a frictional resistance whose coefficient is represented by f . Assuming that the Reynolds number $\frac{V}{DV}$ is implicated in some manner in the definition of f , an analysis of commercial coupling

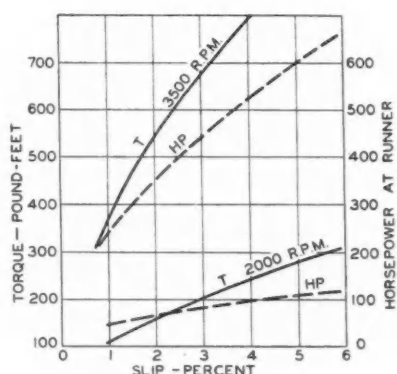
ratings shows that the value

$$f = 0.075 \left(\frac{\nu}{DV} \right)^{\frac{1}{4}}$$

is consistent with good practice. It is about double the coefficient determined empirically for turbulent flow in rough-walled pipes. The symbol ν represents the kinematic viscosity of the liquid in centistokes.

A few working equations are included in Fig. 2, together with some computed torque and power curves for a coupling of the same overall dimensions as that suggested by Mr. Heldt. The fluid was assumed to have a specific gravity of 0.88 and a Saybolt Universal viscosity of 90 sec.

H. A. HUEBOTTER.



$$V = \sqrt{\frac{HD}{L_f}} \text{ ft. per second}$$

$$H = 0.0000142 (r_4^2 - r_s^2)(n^2 - N^2) \text{ inches}$$

$$L = (r_4 - r_s)\pi \text{ inches}$$

$$f = 0.075 \left(\frac{\nu}{DV} \right)^{\frac{1}{4}} \text{ empirical coefficient of fluid friction}$$

$$\nu = 0.226t - \frac{195}{t} \text{ centistokes } t < 100$$

$$\nu = 0.220t - \frac{135}{t} \text{ centistokes } t > 100$$

$$t = \text{Saybolt universal seconds}$$

$$V = 0.00388 \left(\frac{D^3}{\nu} \right)^{1/7} \left[(r_4 + r_s)(n^2 - N^2) \right]^{4/7} \frac{\text{ft.}}{\text{sec.}}$$

$$W = 12 AV\rho \text{ lb. fluid per second}$$

$$A = 5.5 Dr_4 \text{ sq. in. area of fluid path}$$

$$T = 0.00027 AV\rho (r_4^2 n - r_s^2 N) \text{ lb. ft.}$$

$$Hp = \frac{TN}{5250} \text{ Power at runner}$$

$$\rho = \text{fluid density lb. per cu. in.}$$

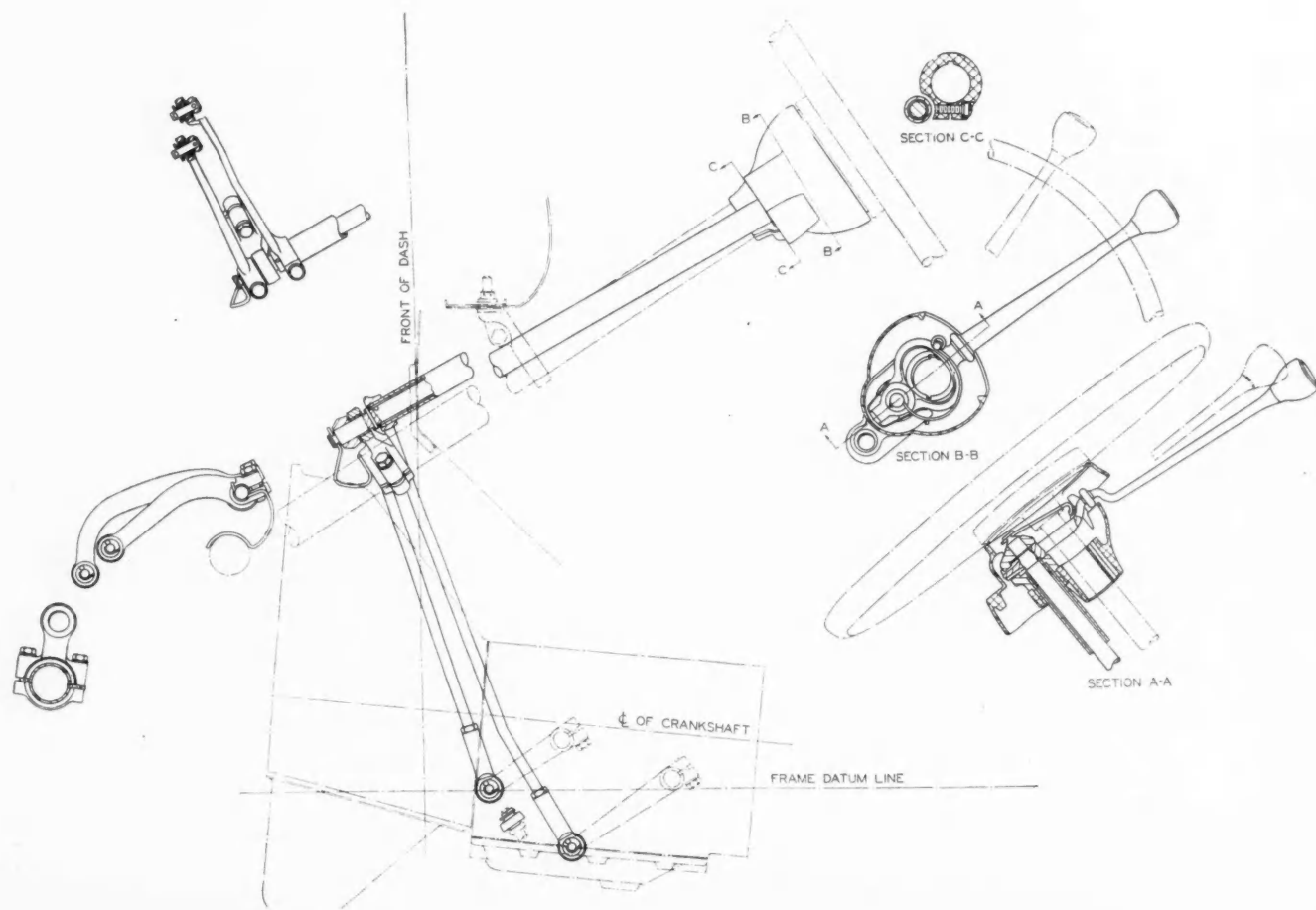
$$\text{Energy loss due to slip} = 0.0081T(n - N) \text{ B.t.u. per min.}$$

Figure 2

CADILLAC STEERING COLUMN AND TRANSMISSION CONTROL

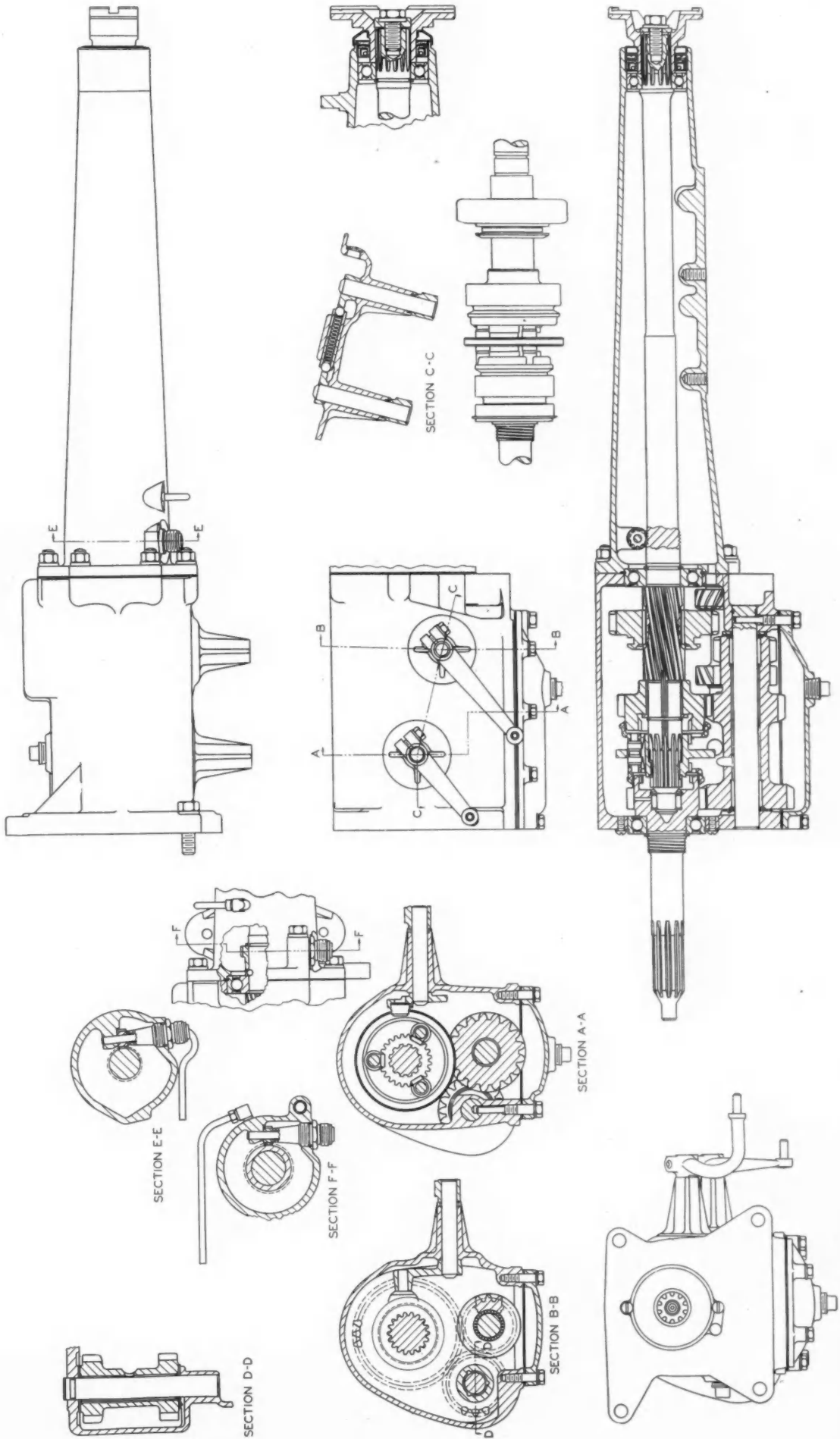
The accompanying drawings show the Cadillac three-speed-and-reverse transmission and the shift lever mounted on the steering column underneath the steering wheel. The transmission is of the all-helical type, with synchromesh shift between intermediate and high gears. The cluster gear, which is mounted on small-roller bearings on a stationary stud, carries four gears, of which the low-speed pinion is located at its extreme rear and the reverse pinion immediately forward of the low-speed pinion. As has been customary with Cadillac for quite a number of years, the final drive shaft extends quite a distance to the rear, through a trumpet-shaped housing bolted to the transmission case, the object being to reduce the length of the propeller shaft and its tendency to whirl. Gear shifting is accomplished by means of two shifter levers inside the housing, whose shafts extend through the side of

the housing and carry lever arms at their outer ends, from which there is connection by links to two corresponding arms at the bottom of the steering post. One of these arms is carried by a tube and the other by a solid shaft within the tube. Both the solid and the tubular shaft extend up the steering column to close under the steering wheel and the shift lever underneath the steering wheel can be engaged with one or the other by an up-and-down motion, while angular motion of the shift lever shifts the gears in the transmission housing. Drifting of the sliding members inside the transmission housing is guarded against by the spring-and-ball lock arranged between the two shafts extending from the housing, as clearly shown in Section C-C. Numerous other features of design are shown by several detail views on the facing page.



DETAILS OF 1940 CADILLAC TRANSMISSION

See Preceding Page for Description



The Maximeter

A DEVICE for determining the maximum combustion pressures in the cylinders of internal combustion engines has been developed by Tchang te-Lou and J. R. Retel of 28 Avenue du President Wilson, Cachan (Seine) France, and is being marketed under the above name.

In the case of multi-cylinder engines, an indicator is fitted into each cylinder. Within this indicator there is an elastic diaphragm of which one side is exposed to the pressure within the combustion chamber and the other to the pressure of an inert gas obtained from a pressure vessel, or "gas bottle." A pressure-reducing valve permits of varying the latter pressure at will, and the pressure is read off on a pressure gage which is carried in a case. As long as this pressure is less than the maximum developed in the cylinder, the diaphragm of the indicator is raised. This closes an electric circuit which, in turn, lights up an electric lamp located adjacent to the pressure gage. It is, therefore, only necessary to increase the pressure gradually and to read off the

pressure shown by the gage at the moment the lamp goes out in order to have the maximum pressure produced in the cylinder.

The complete apparatus consists of an instrument case, a tubular manifold to which the indicators in the different cylinders are connected, and a wiring harness connecting all of the indicators to the instrument case. Indicating lamps corresponding to the different cylinders are arranged around the pressure gage, which makes it possible at a glance to ascertain the degree of regularity of operation of the cylinders. All indicators are subjected to the same "gas," pressure, and as soon as this gas pressure becomes equal to the maximum produced in any cylinder, the corresponding lamp becomes extinguished. The drawing, herewith, shows the application to a radial-type engine.

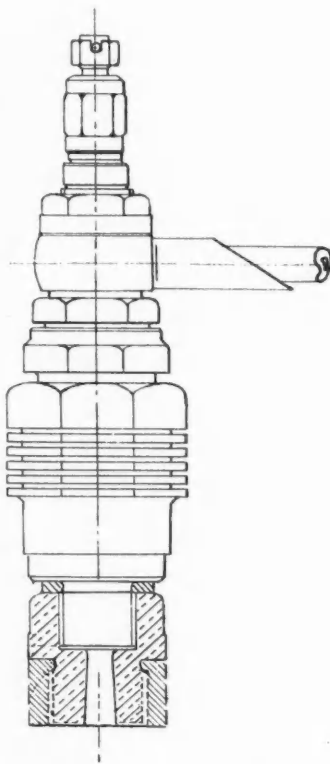
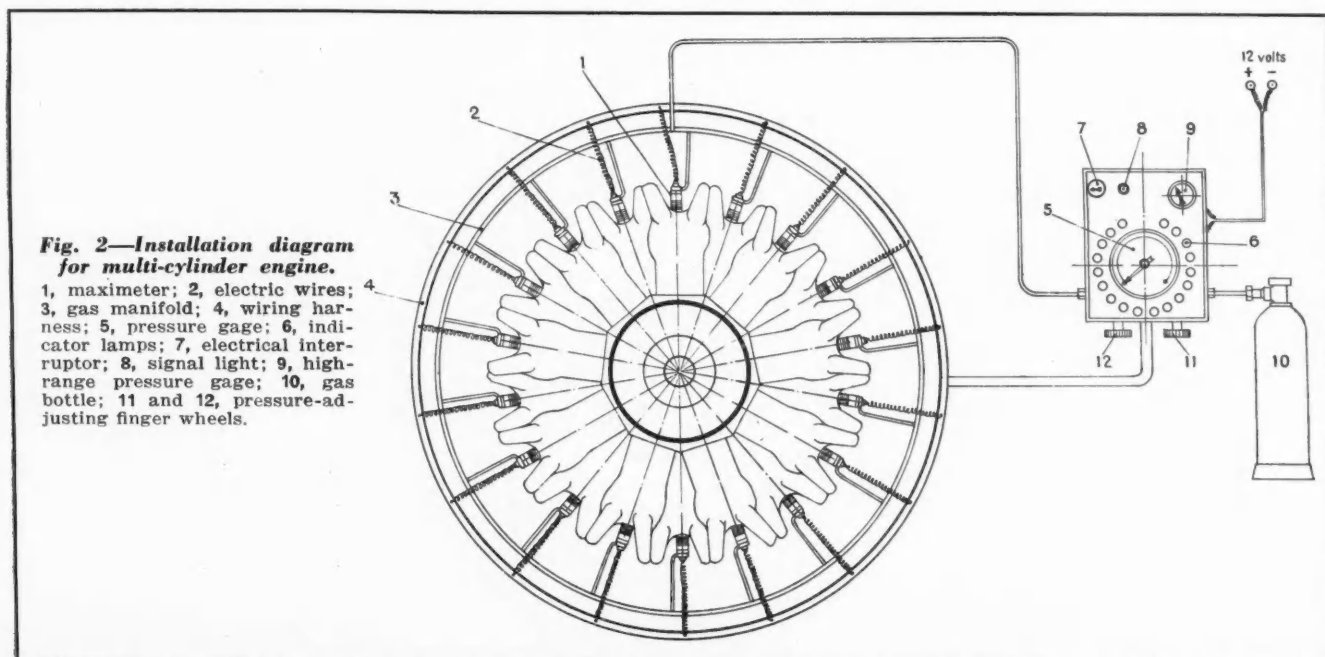


Fig. 1—Maximeter indicator



Production Lines

Diesel Progress

In a recent talk before the Detroit Adcraft Club, Volney Fowler, Detroit Diesel division of General Motors, estimated that there are about 15,000 Diesel vehicles on American highways. This is amazing progress for a development which was in its swaddling clothes but a few years ago. Incidentally, the speaker gave a pointed answer to questions concerning the future of Diesel engines in passenger cars. According to a good engineering estimate it would take about 40,000 miles of operation before the fuel savings in a low-priced passenger car could amortize the first cost of the engine. That seems to be that. On heavy duty equipment, the story is quite different. When buses and trucks regularly chalk up 150,000 to 200,000 hard miles per year, they can make money on fuel savings regardless of the first cost of a dependable Diesel. Volney has done a splendid job in emphasizing these basic considerations.

Extra Pep

We are advised, confidentially, of the development of a new type of electrolyte for storage batteries which is intended primarily for sale as a "replacement" item, i. e., as a substitute for the electrolyte in batteries now in service. It is claimed that the material is non-corrosive, beneficial to an old battery, promotes greatly lowered internal resistance. According to the producers, batteries operated with this electrolyte tolerate an unusually heavy boost charge without injury, and appear to possess great recuperative power after repeated discharge. We have no further information on the subject but we understand that the producer will be glad to supply experimental fillings of this material so that the claims may be substantiated by actual trial.

Speed Control

One of the prominent engine governor companies has developed a unique centrifugal governor for truck and industrial engines. It is exceedingly compact, hence easily accommodated in the engine structure. Best feature of the mechanism is a sharp cut-off curve providing a variation of only about 25 r.p.m. full-load to no-load.

Design Tricks

One of the most practical brochures on design details that we have seen in a long time is a booklet issued on the subject of "Designing for Die Casting" by The New Jersey Zinc Co. Working on the principle that good design and production economy depend upon the little things that may be overlooked, the authors

of this excellent treatise have concentrated on design details with pointed illustrations. Among the items covered are—blind holes, bosses, fillets, plain flat areas, studs, shadow marks, undercuts, metal-saving cores, and more along that line. We urge you to get a copy for your own desk. Ask us for it.

Finishes Blocks

One of the prominent tractor builders is taking delivery of the most advanced group of machine tools the industry has ever seen. The equipment consists of a group of interconnected machines forming a tight battery for finishing all of the drilling, tapping, and boring operations on all sides of a cylinder block. Moreover, the tooling, work-holding fixtures, clamping devices, and conveyor all are arranged to handle three different sizes, taken in lots. All of the equipment is of unit-type, capable of quick change-over, capable of low replacement cost in the event of major changes in product design. The entire battery is fully automatic in its operation.

Speed Control

An inventor has drawn our attention to a new device (patents applied for) which has to do with providing a means of automatic speed control and gear shifting for conventional synchro-mesh transmissions suitably altered to accommodate the device. While details of the mechanism have not yet been disclosed, in general it combines governed speed control with the positioning of the accelerator linkage.

In Offing

Recent trip around parts makers' circles indicated some intense activity by way of new developments in clutches and transmissions. The clutch is a simple mechanism, employing a unique principle designed to cut cost to the bone. Needless to say, the transmission work is all along the line of automatic mechanism, some entirely mechanical, several based on hydraulic elements.

On Balancing

A handsome brochure on the theory and general practice of static and dynamic balance is off the press and is being distributed by Gisholt Machine Co. After discussing the theory of balancing, the bulletin goes on to describe the principle of operation of the Dynetric balancing machines. An interesting section is devoted to some actual applications which point the way to a wider utilization of this valuable production technique. We shall be glad to see that you get a copy.—J. G.

Cam Gear Design for Restricted Space

By P. M. HELDT

IT SOMETIMES happens that the space available for the foot of the tappet in engines with mushroom-type tappets is limited. This condition arises particularly in connection with V-type engines where the single camshaft is located directly over the crankshaft and the axes of the valve tappets for the two blocks intersect the camshaft axis. A special type of cam adapted to these conditions, which permits of a tappet foot of smaller radius for a given valve lift, was described by Chris H. Bouvy in *AUTOMOTIVE INDUSTRIES* of June 16, 1934. With the ordinary type of cam for use with mushroom-type tappets, the lifting portion consists of two circular arcs, the flank arc and the top arc. As long as the tappet contacts the cam on the flank arc, the valve is being accelerated in the "lifting" direction, while during the period the tappet contacts the top arc, the lifting motion is decelerated.

In Mr. Bouvy's special cam the lifting portion of the cam outline is made up of three curves, viz., a flank arc which accelerates the tappet upward; an intermediary curve of involute form, which causes the tappet to be lifted at a uniform rate, and a top arc, which causes the motion to be decelerated.

When it is not desired to use a special form of cam the problem arises as to the minimum radius of tappet foot that can be used with the conventional type of cam. It is evidently desirable to have full-width contact on the cam even when the line of contact is farthest from the axis of the tappet. The geometrical relations then are as shown in the drawing herewith, in which

R is the radius of the flank arc;

R_1 , the base-circle radius;

R_2 , the minimum permissible radius of the tappet foot;

r , the radius of the top arc;

D , the distance between the centers of base circle and top circle;

ϕ , one-half the angle of cam rotation during which the valve is lifted;

θ , the angle of cam motion during which the tappet contacts the flank arc;

l , the lift of the valve, and

w , the width of the cam.

It is obvious from the geometrical relations that the value of R_2 is given by the equation

$$R_2 = \sqrt{\left(\frac{w}{2}\right)^2 + (R - R_1)^2 \sin^2 \theta}$$

The value of D is found from the equation

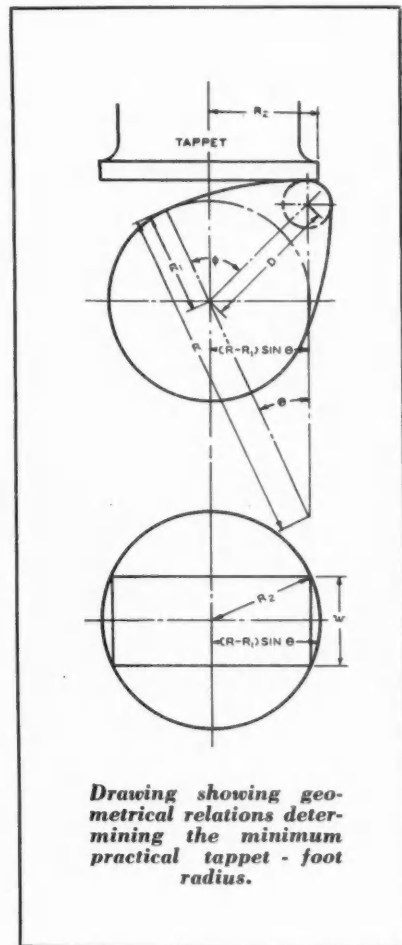
$$D = R_1 + l - r, \text{ and}$$

$$\sin \theta = \frac{D}{R - r} \sin \phi.$$

R , R_1 , r , w and ϕ are established by the design of the cam.

Of course, the minimum permissible radius R_2 can also be determined graphically, but the analytical method gives more accurate results.

Recently it has become the practice to make the contact surface of the valve tappet a spherical segment of large radius, instead of a plane surface, so as to prevent point contact in case of imperfect perpendicularity between camshaft and valve tappet; but it would seem that the minimum radius of the tappet is not affected thereby, for if the radius were made smaller, some of the width of the cam would be useless and the cam might just as well be made narrower.



Drawing showing geometrical relations determining the minimum practical tappet - foot radius.

NEWS OF THE INDUSTRY

"Old Timers" Group Formally Completed

A national organization of automobile old timers, which has been in the process of formation for several months, was formally completed recently at a meeting of the organizing committee and the incorporators held in New York City. The new organization has been incorporated under the membership corporation law of the State of New York, as the Automobile Old Timers, Inc. The organization plans include membership representation throughout the nation, and it was announced at the meeting that upwards of 600 pioneers have already indicated their desire to be enrolled as members.

Any person who has been associated in the motor vehicle sphere for at least twenty-five years, prior to the date of application is eligible for membership. The annual dues are \$5, with a life membership at \$50. The first 250 applications for membership received and accepted are to be classed as charter members for the ensuing year.

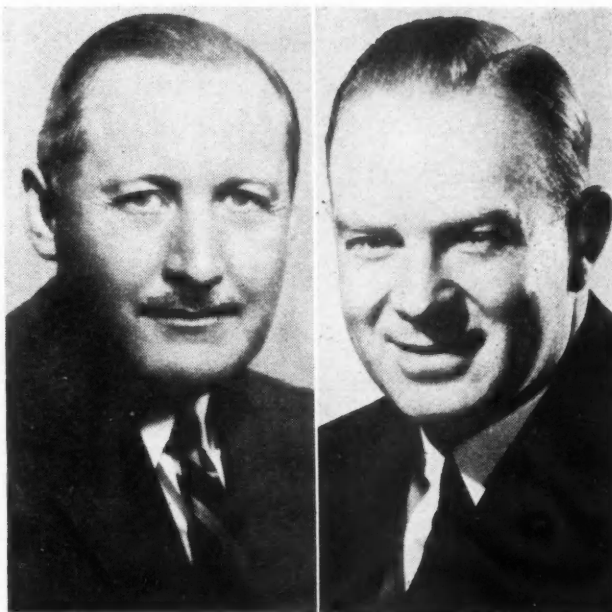
The incorporators serving as the first members of the board of directors include Dave Hennen Morris, president of the Automobile Club of America in 1904 and former United States Ambassador to Belgium; William H. Hotchkiss, president of the American Automobile Association in 1907.

David Beecroft, of Bendix Aviation, and former president of the Society of Automotive Engineers; George Conrad Diehl, president of the American Automobile Association in 1921, and a pioneer advocate for good roads; Arthur Lee Newton, president of the Glidden Buick Co., who began selling automobiles in 1899; Charles B. King, who built and drove the first motor car over the streets of Detroit in 1894; Elmer Thompson, secretary of the Automobile Club of America; and Harry G. Bragg, general manager of the Automobile Merchants Association of New York.

The directors elected the following officers who will comprise the executive committee, and serve until the first annual meeting of the organization, which will be held in New York City, in October, during the week of the national automobile show. Honorary president, D. H. Morris; president, W. H. Hotchkiss, first vice-president, G. C. Diehl; second vice-president, D. Beecroft; third vice-president, C. B. King; treasurer, E. Thompson; and secretary, F. H. Elliott, who was secretary of the American Automobile Association from 1907 to 1910, and organized the new national organization of old timers.

GM Elects

Harlow H. Curtice (left) and Paul Garrett, recently elected vice-presidents of General Motors Corp. Mr. Curtice entered the automotive industry as an accountant with AC Spark Plug Co. in 1914. Most recently he has been general manager of the Buick Motor division of GM. Mr. Garrett has been director of public relations for GM for the past nine years.



Machine Tool Executives Discuss Electrification

Problems related to the electrification of machine tools received the enthusiastic attention of more than 100 machine tool executives and Westinghouse engineers at the fifth annual Machine Tool Electrification Forum held at East Pittsburgh, Pa. on May 6, 7 and 8 under the sponsorship of the Westinghouse Electric & Mfg. Co. Some 75 companies were represented in the group of engineers and designers attending the three-day series of "round-table" conferences. Several of the technical papers delivered at the Forum will be discussed in future installments of *Men and Machines*, which appears in each issue of *AUTOMOTIVE INDUSTRIES*.

Delegates were welcomed at the opening session by Bernard Lester, a special representative of Westinghouse, who introduced R. S. Kersh of the company's machinery electrification section, in charge of forum arrangements.

Ford Breaks Precedent Joins National Auto Show

Ford Motor Co. this year for the first time joins other manufacturers in exhibiting its products at the National Automobile Show to be held in New York, Oct. 12-19. Until this year, Ford has held its own showing concurrent with that of the other manufacturers

but in another building. Exceptions to this were in 1910 when Ford exhibited at a show of unlicensed manufacturers and in 1935 when the company participated in a New York dealer show.

The company plans to exhibit its Ford, Mercury and Lincoln-Zephyr cars and also models of Ford trucks and commercial cars.

Motor Wheel Reports On Quarter Profits

Motor Wheel Corp. reports for the quarter ended March 31 a net profit of \$614,208 against \$420,405 for the first quarter 1939. Net profit for the 12 months ended March 31 was \$2,043,042 compared with a net profit of \$1,111,600 earned in the previous 12 months.

Court Affirms Diesel Duty

The United States Court of Customs and Patents Appeals on May 6 announced affirmation of the decision of the United States Customs Court assessing additional duties of 1 per cent of the appraised value of imported Diesel engines and parts because of alleged undervaluation. The engines and parts were entered at the gross invoice value, less 25 per cent and 2½ per cent. After reappraisal proceedings it was finally determined that the dutiable value was the invoice price less 10 per cent and 2½ per cent. Bolinders & Co., importers, had protested assessment of the additional duties of 1 per cent.

U. S. Trucks Relieve French Civil Transport Situation

Allies Study Merits of Carburetors and Injectors for Aircraft Use in Wartime

(By W. F. Bradley, AUTOMOTIVE INDUSTRIES' Correspondent in France.)

American trucks are now in service with the French army. The first to go into operation were Studebakers, followed by White, Dodge, and G.M.C. While practically standard models, equipment comprises external gas tank, closed driver's cab, rectangular radiator guard, a separate guard in front of each headlight, a platform body with detachable canvas top and oversize dual tires. One of the G.M. shops in France is unboxing and assembling 5000 American motorcycles, most of them with side-cars.

The arrival of American trucks doubtless will relieve the civil transport situation, which is far from satisfactory. Since the end of August new vehicle registrations have been very low, varying from 4000 to 6000 per month, compared with 12,000 to 18,000 a year ago. These official figures include both passenger cars and trucks. There are no stocks of used trucks and manufacturers and importers of new trucks of more than 3000-lb. load capacity are not allowed to sell to civilians without

a special permit. High-powered used passenger cars are available, but sales are sluggish because of gasoline restrictions. Prices of small cars, both new and used, are soaring. Every week the army turns over a number of trucks for sale by auction, but nearly all of these are in need of more or less extensive repairs and skilled labor is difficult to obtain.

Railroads, which for a number of years have very successfully fought trucking interests, now refuse to carry freight for distances of less than 15 miles.

Injector vs. Carburetor

Numbers of German planes are fitted with gasoline injection in place of a carburetor. This has raised the cry in Allied circles that the injector must have advantages over the carburetor, or it would not be used by the German air force, and in certain circles it is maintained that the French and English ought to switch to injectors. There is every reason to believe that technical considerations did not dictate Germany's choice. Six years ago the Bosch Com-

pany of Stuttgart, made it known that it was about to start carburetor manufacture. In reply to this the Solex Company, which practically dominates the French market and has important interests in Germany, announced that it would enter the injector field, which is almost entirely held by Bosch. The outcome was a signed agreement between Solex and Bosch, in which the former undertook not to manufacture injectors and the latter agreed to keep out of the carburetor field.

The German authorities, finding that they were dependent on foreign countries (Solex, French, and Stromberg, American) for their carburetor technique, instructed Bosch to push injector development for aero engines. After working on the problem for five years, injectors have been perfected, but, it is claimed, they offer no technical advantages over the carburetor and their servicing is much more difficult. The injector prevents freezing; but with the Hispano-Suiza-Solex device with the compressor blowing on the carburetor, this difficulty is effectively overcome. The main practical disadvantage of the injector is that it loads up the engine with gas when on a steep dive, causing spluttering when pulling out. French and English pilots have frequently claimed to have brought down German planes which were emitting black smoke, when that smoke was only caused by the injector pumping an excess of gasoline into the cylinders.

French carburetor experts deny that Germany has been forced to the use of low grade gasoline on airplane engines and at the time when production is all important they oppose any stampede to the injector merely because it is used by Germany.

Three-Month Automotive Exports and Imports

	MARCH 1940		MARCH 1939		THREE MONTHS ENDED MARCH			
					1940		1939	
	No.	Value	No.	Value	No.	Value	No.	Value
EXPORTS								
Automobiles, parts and accessories.....		\$ 29,325,952		\$ 28,503,655		\$ 76,896,844		\$ 75,235,094
PASSENGER CARS								
Passenger cars and chassis.....	10,738	6,646,187	17,874	11,165,435	33,762	20,594,256	48,890	29,983,679
Low price range \$850 inclusive.....	9,482	5,361,433	15,873	9,045,259	29,747	16,491,135	43,221	23,963,038
Medium price range over \$850 to \$1,200.....	1,067	997,153	1,732	1,648,136	3,505	3,309,872	4,876	4,666,708
Over \$1,200 to \$2,000.....	172	248,507	216	323,892	467	677,660	646	980,155
Over \$2,000.....	15	39,094	53	148,188	43	115,589	147	373,778
COMMERCIAL VEHICLES								
Motor trucks, buses and chassis (total).....	15,606	13,743,671	12,045	7,800,590	35,433	28,921,775	31,996	19,752,282
Under one ton.....	2,442	1,172,281	1,947	869,259	5,229	2,401,974	4,655	1,983,800
One and up to 1½ ton.....	8,703	5,151,343	8,383	4,765,168	20,924	11,600,862	22,611	12,048,185
Over 1½ tons to 2½ tons.....	3,172	4,474,293	952	842,926	6,643	9,077,129	3,086	2,682,306
Over 2½ tons.....	1,271	2,929,538	679	1,235,338	2,537	5,696,920	1,351	2,806,131
Bus chassis.....	18	16,216	84	87,699	97	144,890	293	231,840
PARTS, ETC.								
Parts except engines and tires.....								
Automobile unit assemblies.....		3,467,111		4,340,434		12,609,454		12,080,508
Automobile parts for replacement (n.e.s.).....		4,261,120		3,485,957		10,935,112		9,242,718
Other automobile accessories (n.e.s.).....		423,994		327,760		1,180,940		871,772
Automobile service appliances.....	1,234	378,817	2,033	507,948	2,283	976,715	4,833	1,435,265
Airplanes, seaplanes and other aircraft.....	191	14,527,104	132	5,948,017	567	44,995,955	318	12,659,798
Parts or airplanes, except engines and tires.....		20,735,688		8,740,795		66,816,208		20,406,195
INTERNAL COMBUSTION ENGINES								
Stationary and Portable.....	96	218,371	59	195,578	221	524,409	99	308,455
Diesel and semi-Diesel.....								
Other stationary and portable.....	1,579	93,974	2,057	94,017	4,212	245,440	3,483	188,002
Not over 10 hp.....	186	463,726	89	84,017	653	797,038	283	247,668
Engines for:								
Motor trucks and buses.....	2,201	219,013	2,804	331,985	6,643	698,385	7,837	911,763
Passenger cars.....	1,199	112,443	4,257	467,217	6,069	523,046	9,208	884,101
Aircraft.....	290	2,336,593	77	475,237	939	8,192,158	261	1,739,234
Accessories and parts (carburetors).....		381,110		217,591		1,061,324		610,023
IMPORTS								
Automobiles (durable).....	44	44,758	54	36,019	138	148,150	129	96,105

MEMA Index Reveals Continued Advance

March shipments in all branches of the automotive industry with the exception of accessories advanced over the previous month, according to manufacturers reporting their monthly business figures to the Motor and Equipment Manufacturers Association, and with the same exception, all classifications were higher than for March, 1939. The index for all branches of the industry in March rose to 164 (January, 1925, taken as 100) compared with 156 for February and 147 for March, 1939.

Shipments to vehicle manufacturers of original equipment in March advanced to 174, which compares with 167 registered in February and 153 for March last year. Service parts shipments to wholesalers for March increased to 158 as compared to 145 in February. In March, 1939, the index stood at 141. Accessories shipments to wholesalers in March dropped, standing at 82, which compares with 86 in February and 142 in March, 1939.

GM Domestic Sales Show 34% Increase

As indicated in its report to stockholders, the consolidated net earnings of General Motors Corp., including equities in the earnings of subsidiaries not consolidated, for the quarter ended March 31 were \$67,028,461 as compared with \$53,177,928 for the first quarter of 1939.

Total sales to dealers, including overseas shipments from the U. S. and Canadian plants but excluding production by overseas manufacturing subsidiaries, amounted to 549,182 cars and trucks as compared with 431,057 for the first quarter 1939—an increase of 27.4 per cent.

Sales by the corporation to dealers within the United States during the first quarter of 1940 amounted to 506,449 cars and trucks as compared with 375,597 for the corresponding period a year ago—an increase of 34.8 per cent.

Stockholders adopted a contributory retirement plan for employees earning in excess of \$3,000 yearly at the annual meeting. All corporation directors were reelected.

The plan, effective July 1, calls for all employees earning more than \$3,000 annually and more than 40 years of age to contribute 5 per cent of their monthly salary in excess of \$250 up to the age of 60.

The corporation will contribute the remainder of the cost to operate the plan. Officials estimated the cost to the corporation the first year at \$700,000.

The monthly retirement benefit will be equal to one and one-half per cent of the amount of the average monthly salary which is in excess of \$250 a month, multiplied by the number of years the employee has contributed under the plan. The normal retirement age was set at 65.

Borg-Warner Corp. Profits in Quarter

Net income of Borg-Warner Corp. and all subsidiaries for the first quarter 1940 has been reported as \$1,776,240.49. Net income for the first quarter 1939 was \$1,154,704.91.

At the annual meeting stockholders reelected all directors and all officers of Borg-Warner Corp. were renamed by the board.

C. H. Johnson

Charles H. Johnson, executive vice-president and director of Gisholt Machine Co., died April 23 at the age of 58 years. His entire life was spent in the machine tool industry, having started to work for Gisholt as a machinist in 1897 while he was still in his teens. In 1918 he was promoted to a vice-presidency in the company and in 1932 he became executive vice-president.

Diesel

S. A. Guiberson (right) and his son, Allen, of Dallas, Texas, president and vice president, respectively, of Diesel Engine Co., look over their Diesel airplane engine. The engine was demonstrated recently in Washington before Secretary of War Woodring and Army and Navy officials.



Acme

Brake Tester for Standards Bureau

The Bureau of Standards has installed a new inertia-type machine for testing brake lining, designed by Rolla H. Taylor and William L. Holt, with the advice and cooperation of members of the Brake Lining Manufacturing Association, says the Bureau's Technical News Bulletin. Although smaller, it is similar in operation to machines used in the industry. A heavy flywheel is brought up to the

desired speed, the power is then shut off and the flywheel stopped by means of a brake mechanism which employs the lining under test. The energy absorbed per square inch of lining in stopping the flywheel is comparable to the energy absorbed in stopping an automobile. Tests of brake lining include two types of measurements: (1) Determination of the coefficient of friction of the lining under various conditions, such as when the lining is hot or cold, wet or dry; and (2) determination of the rate of wear.

Truck Production by Capacities (U. S. and Canada)

	THREE MONTHS			Per Cent of Total	
	1940	1939	Per Cent Change	1940	1939
1½ Tons and less.....	197,079	189,357	+ 4.0	89.14	92.46
2 to 3 tons.....	14,332	8,889	+ 61.7	6.48	4.34
3½ Tons and over.....	3,087	2,939	+ 5.1	1.40	1.44
Special and buses.....	1,500	1,276	+ 17.5	.68	.62
Station Wagons.....	5,083	2,341	+107.0	2.30	1.14
Total.....	221,081	204,802	+ 8.0	100.00	100.00

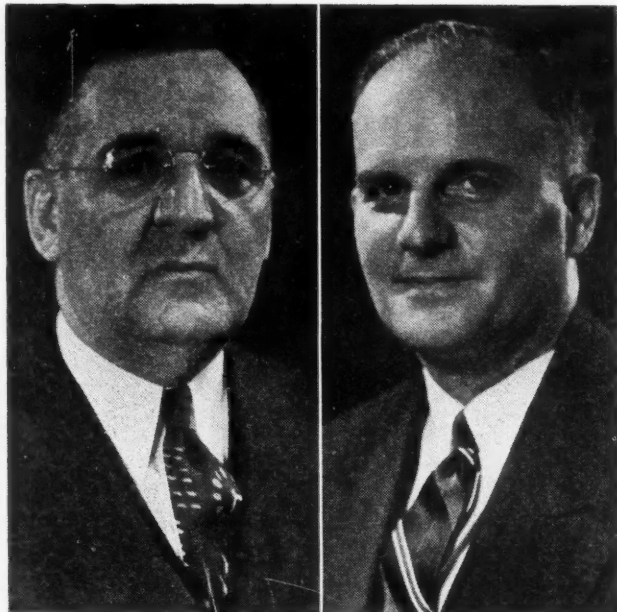
Estimated Dealer Stocks of New Passenger Cars

1939	January	February	March	April	May	June
Production—U. S. Domestic Market †.....	262,330	223,795	279,146	257,058	222,909	233,311
Retail Sales—U. S. ‡.....	180,692	165,865	276,364	265,992	276,719	254,604
Change in Inventory.....	+81,638	+57,930	+2,784	—8,934	—53,810	—21,293
Inventory, first of month.....	261,980	343,618	401,548	404,332	395,398	341,588
1939 (continued)	July	August	September*	October*	November*	December*
Production—U. S. Domestic Market †.....	142,346	56,245	155,430	239,150	272,747	357,712
Retail Sales—U. S. ‡.....	229,873	166,172	139,222	236,584	257,398	274,233
Change in Inventory.....	—87,527	—109,927	+16,208	+2,566	+15,349	+83,479
Inventory, first of month.....	320,295	232,768	122,841	139,049	141,615	156,964
1940	January*	February*	March	April	May	June
Production—U. S. Domestic Market †.....	348,755	324,555	341,634	.....	.....	.....
Retail Sales—U. S. ‡.....	239,509	236,856	338,082	.....	.....	.....
Change in Inventory.....	+109,246	+87,699	+3,552	.....	.....	.....
Inventory, first of month.....	240,443	349,689	437,388	440,940	.....	.....

†—U. S. Census Bureau.

‡—Automobile Manufacturers Association.

*—Revised.



Named V.P.'s

C. David Widman (left) and L. Clayton Hill have been elected vice-presidents of The Murray Corp. of America. Mr. Widman was formerly secretary and treasurer, and Mr. Hill was manufacturing manager of the corporation.

GM Encourages Youth At World's Fair Preview

Technological advancements and research offer youth of today unparalleled advantages in American industry today, seven eminent industrialists, educators, and writers told more than 400 undergraduates from eighty colleges and universities Monday night (May 6) at the General Motors preview dinner at the New York World's Fair.

Scores of pertinent questions ranging from "how can I get a job" to "does a college education pay," culled from 600 questions submitted by the students, were answered by a board of four experts under "Information Please" procedure under Clifton Fadiman, master of ceremonies. The experts were Dr. Carl T. Compton, president of Massachusetts Institute of Technology; Dr. Ernest M. Hopkins, president of Dartmouth College; General Hugh S. Johnson, and Charles F. Kettering, vice-president in charge of research, General Motors Corp. Addresses were also made by Alfred P. Sloan, Jr., chairman of General Motors Corp., William S. Knudsen, president, and Mr. Kettering.

Many of the questions asked indicated that the college students feared that industry had advanced to a stage where opportunities were limited, and the future was gloomy.

The speakers confirmed Mr. Kettering's view that American industry is still in the "horse and wagon stage of development," and hard work, common sense, and ability to fit into the opportunities offered by American manufacturing and distribution organizations are all that is needed to achieve success.

Several answers indicated that a college or technical education, per se, is of no value. Dr. Hopkins and Dr. Compton both went on record with declarations that many college graduates had wasted their years in school because they

thought there was some magic in a college degree.

Mr. Kettering said that the "shirt-losing period of new developments" was industry's greatest hazard today. The money required to market a product, even after it has been developed, is a discouraging prospect. General Johnson condemned the tax policies of the government, saying that business men were discouraged by both high taxes and lack of adequate compensation in case of loss in promoting a new product.

Mr. Knudsen declared that only experience will tell a young man whether he has real aptitude for research, selling, or manufacturing, and suggested that graduates be patient doing menial tasks until they found themselves.



Paul Garrett, director of public relations for General Motors Corp., has been named chairman of the program committee of the Advertising Federation of America's annual convention in Chicago, June 23-27.

A. A. Shantz has been appointed assistant general parts and service manager of the General Motors Truck and Coach division of Yellow Truck and Coach Manufacturing Co.

Ralph Hayes, vice-president, Coca-Cola Co., has been elected to the board of directors of Studebaker Corp.

F. L. LaQue is now engaged in development activities on all applications of both ferrous and non-ferrous nickel-containing alloys for International Nickel Co., Inc. Dr. W. A. Mudge succeeds Mr. LaQue as assistant director of technical service.

C. J. Martin has been appointed chief engineer of Federal Machine and Welder Co. He was formerly machinery salesman and sales engineer with Ex-Cell-O Corp.

S. F. Newman has been elected president of Landis Tool Co. and M. A. Hollengreen has been advanced from the office of assistant general manager to that of vice-president.

L. M. Benkert has been named general manager of Progressive Welder Co.

Coordination of pressed steel operations of Republic Steel Corp. and subsidiaries under the general management of F. R. Schaefer has been announced. He will also serve as general manager of the pressed steel division of Truscon Steel Co., the position previously held by Harry Woodhead, who has resigned to become president of Aviation Manufacturing Corp.

F. J. Schuman has been named works manager of Federal Machine and Welder Co.

G. C. Miller has been appointed sales manager of the plastics division of Carbide and Carbon Chemicals Corp.

N. K. VanDerzee has been appointed eastern sales manager of Hudson Motor Car Co.

O. L. Bard, for the past 17 years secretary of Michigan Tool Co., was elected president and treasurer at the annual meeting of the board of directors. Also elected were M. R. Anderson, as vice-president, and Arvid Lundell, as secretary.

W. B. Hurley, staff engineers, sales department, Detroit Edison Co., has been appointed assistant district chief of the Detroit Ordnance District under Alex Dow, civilian district chief.

T. B. Danckwortt, of the Danckwortt Diesel Engineering Co., Balboa, Calif., plans to make a business trip through the East and Middle West in June. The Danckwortt Company pioneered the Daco two-stroke horizontal two-piston engine which is said to be in production in European countries.

E. L. Ryerson, Jr., has been elected chairman of the board, Inland Steel Co. He succeeds L. E. Block, who has become chairman of the executive committee. P. D. Block, president, and all other officers and directors have been reelected.

H. C. Fruehauf, of Fruehauf Trailer Co., has been chosen chairman of the board of directors of the newly organized Truck Trailer Manufacturers Association. M. J. Neeley was named president; P. H. Bartlett, vice-president; and E. J. Lucas, treasurer.

For reasons of health G. T. Bishop has resigned from the board of directors of Goodyear Tire & Rubber Co. He is succeeded on the board by A. G. Cameron, head of Goodyear foreign sales.

E. C. Paddock has been appointed sales manager of Corbin Screw Corp.

Col. J. Monroe Johnson, Assistant Secretary of Commerce, has been nominated by President Roosevelt to be a member of the Interstate Commerce Commission, to succeed Marion M. Caskie, resigned. President Roosevelt has announced that he will name Robert H. Hinckley, Chairman of the Civil Aeronautics Authority, to succeed Colonel Johnson as Assistant Secretary of Commerce.

Three new directors were announced at the annual meeting of the Automotive Parts and Equipment Manufacturers, Inc., in Detroit. The new board members are Simon D. Den Uyl, secretary of the Bohn Aluminum and Brass Corp., Detroit; James Y. Scott, president of the Van Norman Machine Tool Co., Springfield, Mass.; and J. O. Eaton, chairman of the board of the Eaton Manufacturing Co., Cleveland. Each was elected for a two-year term. Mr. Den Uyl was named a director-at-large, while Mr. Scott will serve as head of the shop equipment division and Mr. Eaton will head the accessories division. Clarence C. Carlton, vice-president and secretary of the Motor Wheel Corp., Lansing, was elected to his eighth consecutive term as president, having headed the organization ever since it was founded in 1933.

Studebaker Profit at \$511,503 for Quarter

The Studebaker Corp. reports consolidated net profit of \$511,503 for the quarter ended March 31, 1940, compared with \$56,914 earned in the same period last year. First quarter profit this year equaled 23 cents per share of common stock outstanding against 2 cents a share for the 1939 period. Net sales for the first quarter totaled \$20,497,466, the largest for the period since 1929 and an increase of 36 per cent over sales of \$15,095,249 in the corresponding 1939 quarter.

Rubber Consumption Sets New Record

Consumption of crude rubber in the United States during 1939 totaled 592,000 long tons, a new all-time record and 14,000 tons more than the preliminary trade estimate, according to the Leather and Rubber Division, Department of Commerce. Stocks of rubber in the United States at the end of 1939 are officially estimated at 125,800

AUTOMOTIVE INDUSTRIES

Summary of Automotive Production Activity

BUSES Deliveries tapering off after an excellent first quarter, but prospects for several large shipments appear excellent for the near future.

TRUCKS Some producers reporting substantial increase in schedules. Sales reports in many cases show from 15 to 20 per cent increase over last year. Smaller manufacturers report the largest percentage gains in deliveries.

TRACTORS Despite heavy schedules, backlogs in some plants are piling up but seasonal activities in farming are expected to absorb this. Producers optimistic concerning remainder of year.

AUTOMOBILES Production continues well ahead of 1939 even with seasonal decline. Output for first half of May estimated at 212,000 cars and trucks. Retail and used car sales continue good.

MARINE ENGINES Schedules continue far ahead of last year. Sales to owners and shipyards continue to keep most manufacturers busier than at any time in recent years, with several companies reporting backlogs higher than any previous. Small powerplants for pleasure craft going strong.

AIRCRAFT ENGINES Production still at high levels. One source claims industry's output before end of year may be doubled. Increases in backlogs reported.

This summary is based on confidential information of current actual production rates from leading producers in each field covered. Staff members in Detroit, Chicago, New York and Philadelphia collect the basic information, in all cases from official factory sources.

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long tons, the lowest Dec. 31 inventory during the last ten years.

This information is based upon a survey conducted by the Leather and Rubber Division with the cooperation of all branches of the rubber manufacturing and trading industries. The reports received accounted for 98.2 per cent of the rubber available for use.

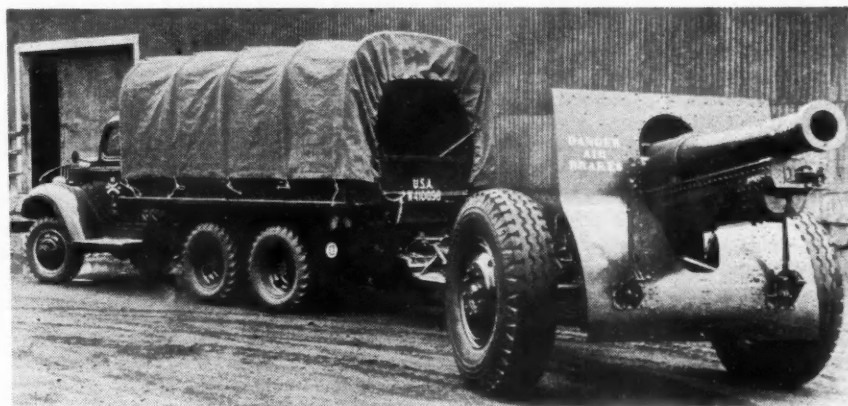
The consumption of crude rubber in 1939 was 25.5 per cent higher than in 1938. Consumption of reclaimed rubber in 1939 is estimated at 170,000 long tons, an increase of 40.7 per cent over 1938, while consumption of Neoprene, Thiccol and imported Buna synthetic rubber is estimated at 1700 long tons, an increase of more than 100 per cent over 1938.

Principal factor contributing to the record consumption figure, the report said, was an unexpectedly large trade in tires for replacements. Growth in

the production of tires for agricultural machinery, advances in sales of sponge rubber mattresses and upholstery, and an unusually large exportation of certain rubber goods as a result of British orders for rubber hose, and the stocking of foreign distributors upon the outbreak of war, were other factors considered significant.

A. J. Lavoie

A. J. Lavoie, president and general manager of the Lavoie Corp. of Defiance, Ohio, and a former member of the engineering staffs of General Motors and Cord, died April 24, following an extended illness. In 1937 Lavoie organized a company at Defiance for experimenting in the application of his patents in the manufacture of a new type of motor bus.



\$2,441,390 Order

One of the specially designed General Motors army trucks shown towing one of the 24 new 155 mm. howitzers of the Michigan National Guard. The truck, a three-ton prime mover, is one of a fleet of 12 assigned to the same unit and similar in design to others being produced by GM in a \$2,441,390 War Department order.



E. S. Chapman

... recently elected vice president in charge of production of Plymouth Motor Corp. He succeeds the late P. C. Sauerbrey. Mr. Chapman has occupied the position of general works manager of Plymouth and now, in addition to being elected a vice president, is also appointed as assistant general manager. A. H. Paterson, former factory manager, has been appointed to succeed Mr. Chapman as general works manager.

Fuel - Lubricants - Cars Developing Hand in Hand

A prediction that the automobiles of the future will travel nearly twice as far on a gallon of gasoline as the cars of today, and will have twice the power of today's cars, was made by Thomas A. Boyd, director of fuel laboratories, General Motors Corp., at a dinner given by The Franklin Institute, Philadelphia, honoring the Atlantic Refining Co. for its pioneer work in many fields relating to the refining, transportation and marketing of petroleum products.

In accepting from Dr. Henry Butler Allen, secretary and director of the Franklin Institute, an Institute citation for the Atlantic Refining Company's contributions to the development of the petroleum industry, Robert H. Colley, president of the company, said, "It is like arguing about whether the chicken or the egg came first when we try to decide whether this country has such cheap gasoline and so many miles of good roads because we have so many automobiles, or whether we have so many miles of good roads and so many automobiles because we have such cheap gasoline. At any rate the fact remains that we have the combination of more miles of good roads, more automobiles and cheaper gasoline than any other country in the world.

"Our American policy of giving the consumer more for his money has been successfully applied in spite of the fact that the price the consumer now pays includes a nearly 5000 per cent increase in taxes. This policy of 'more

for less' originated with American business men. It has nothing to do with subsidies or legislative controls. It is the result of increasing productive efficiency coupled with the practice of passing on the benefits of greater efficiency to the consumer in the form of lower prices.

Waukesha Perfects New Fuel Testing Engine

Waukesha Motor Co. has announced the perfection of a new precision engine to be used to determine the anti-knock rating of aircraft fuel. The new testing unit has been adopted, the company reports, as the only standard unit to be used for such testing in this country.

Production of the engine is reported to have started and a model engine will be on display for the first time at the International Petroleum Exposition in Tulsa, Okla., next month.

Curtiss-Wright Quarter Profit at New Peak

Curtiss-Wright Corp. reports for the first three months of 1940 the largest net profit of any quarter in the aircraft company's history — \$2,414,196. Net profit in the March quarter, 1939, was \$1,698,157.

Wright Aeronautical Corp., controlled by Curtiss-Wright, reports March quarter net income \$1,237,001. In the same period of 1939, profit was \$1,231,725.

P. J. Nagle

Peter J. Nagle, president of Flower City Specialty Co., makers of automotive accessories, died recently in Rochester, N. Y.

NLRB Orders Ford to Bargain

Declares Company Hostile to Labor

Holding that the Ford Motor Co. undertook an "active and open campaign to crush" the CIO-AUW, the National Labor Relations Board has ordered the company to bargain collectively with the union in its St. Louis plant, reinstate 94 employees with back pay and post notices saying it will not interfere with the right of employees to self-organization, or disseminate anti-union statements among them. The board said that in July, 1937, the company's watchmen distributed to the employees a pamphlet entitled "Ford Gives Viewpoint on Labor," and the company maintained that in doing so it simply was exercising its right of free speech.

This pamphlet, the board said, "re-stated and emphasized" Mr. Ford's intention never to "recognize the United Automobile Workers' Union or any other union" and, the board continued, "clearly manifested the company's open and active hostility to labor organizations."

In rejecting the company's contentions that it was "exercising the right of free speech guaranteed by the first amendment to the federal Constitution," in circulating the pamphlet, the board said that "the respondent was not addressing or attempting to influence the public at large; nor was the respondent addressing an argument to the intellect of its employees which they were free to accept or reject without compulsion."

"The respondent was not attempting to engage in the 'free trade in ideas ...

(Top of next column)



Fords Abroad

Some units of a large fleet of canteen-ambulances built by Ford in England for the Salvation Army pictured as they were drawn up before Buckingham Palace awaiting inspection by the King and Queen. Besides full equipment as a canteen, each vehicle holds folding stretcher carriers for emergency use. The extension over the drivers' compartments contains bins, trays and shelves for canteen supplies.

in the competition of the market.'"

On the contrary, the board declared that the company was issuing a "stern warning that it was bitterly opposed to the union and that it would throw the weight of its economic power against the effort of its employees to form or carry on such an organization."

In view of the "systematic employment of unfair labor practices that followed the company's distribution of the pamphlet," the board declared that such distribution was not "mere influence" but constituted "interference, restraint, and coercion, expressly forbidden by the act."

New Plant for Fedders Opens

Announcement of the completion of a new plant equipped with automatic machinery for production of automotive radiators for original factory equipment on automobiles, trucks, tractors, buses and gasoline or Diesel driven industrial units, as well as heaters for cars, trucks and buses, is announced by Fedders Manufacturing Co., Buffalo, New York. This new plant is located at Owosso, Michigan. Together with the long established Buffalo factory, it more than doubles Fedders previous capacity, the company reports.

Gemmer Reports on Six-Month Profit

Financial report of Gemmer Manufacturing Co. for six months ended March 31, 1940, indicates a net income of \$195,882.61. Net income of the Marles Steering Gear Co., Gemmer subsidiary, for the same period was reported as \$52,504.76.

Briggs Reports Gains in 1939

A net profit of \$2,151,142.97 has been reported by Briggs Manufacturing Co. for the year 1939. This was well above the income for the previous year, reported at \$840,459.35.

M.I.T. Plans Friction Surface Finish Meeting

A Conference on Friction and Surface Finish is to be held at Massachusetts Institute of Technology June 5, 6, and 7. Technical papers will be presented at the morning session each day, and there will be discussions on these papers during the afternoon sessions. The purpose of the conference is to bring before engineers a summary of present knowledge regarding friction and surface finish, in the hope of bringing out by discussion what new information is needed and what is the most promising direction of future research in this and allied fields.

On Wednesday, June 5, the follow-



No Tunnel

What appears to be possibly a new vehicular tunnel is merely the partially completed fuselage of one of the new four-engined Boeing Stratoliners. Opening a new era in air transportation, five of these high-altitude planes are expected to be delivered to Transcontinental & Western Air, Inc., by June 1. The Stratoliner fuselage, as may be noted above, is completely circular from nose to tail. Beneath the floor are cargo holds and accessory compartments.

ing papers will be presented: *Some General Aspects of Rubbing Surfaces*, by A. F. Underwood, General Motors Research Laboratories; *Metallurgy of Surface Finish*, by John Wulff, Massachusetts Institute of Technology; *Preparation of Smooth Surfaces*, D. A. Wallace, Chrysler Corp.

The papers on the program for Thursday are as follows: *Description and Observation of Metal Surfaces*, Stewart Way, Westinghouse Research Laboratories; *Surface Friction of Clean Metals*, Hans Ernst, Cincinnati Milling Machine Co.; *Boundary Lubrication*, by C. B. Karelitz, Columbia University.

There are four papers on the program for the last day of the Conference, Friday, June 7, as follows: *On the Mechanism of Boundary Lubrication*, by Otto Beck, Shell Development Co.; *The Effect of Lubricants on Wear of Metals under Conditions of Boundary Lubrication*, by J. C. Geniesse and R. Simard, Atlantic Refining Co.; *Some Features of Laboratory Wear and Friction Testing*, by R. W. Dayton, Battelle Memorial Institute, and a closing paper by A. R. Stevenson, General Electric Co.

Casing Shipments Fall Below March '39 Mark

Shipments of automotive casings during March, 1940, are estimated to have been 4,351,657 units. This is 5.7 per cent higher than the 4,118,030 units shipped during February but is 4.7 per cent below shipments for March, 1939, according to statistics released by The Rubber Manufacturers Association, Inc. Replacement shipments totaled 2,223,765 units in March.

March shipments of casings for original equipment purposes are estimated to have been 2,049,891 units, an increase of 3.8 per cent over the February figure of 1,974,273 units and 14.2 per cent over March, 1939, when original equipment shipments were 1,795,315 units.

March production, estimated at 5,031,153 units, was 2.5 per cent over February but was 1.2 per cent below March, 1939. Automotive casings in the hands of manufacturers, March 31, are estimated to have been 10,836,239 units.

40 YEARS AGO

The Duryea Power Co., of Reading, Pa., has lately increased its capital to \$100,000, and has moved into permanent quarters at North River and Hockley Sts. The officers of the company are: Herbert M. Sternbergh, president; Chas. E. Duryea, vice-president; Henry Milholland, secretary and treasurer, and their goods are being built under license from the Duryea Mfg. Co., of Peoria, Ill. This arrangement secures to this company the services of Chas. E. Duryea, the pioneer gasoline motor vehicle builder of this country.

Work has already been pushed forward in temporary quarters with the Reading Cycle Co.; so that the first lot of vehicles will be finished early next month. The company prefers and recommends the three-wheeled type of vehicle, but builds four-wheelers to order.—From *The Horseless Age*, May, 1900.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE INDUSTRIES

Relative stability of general business activity has continued. The *Journal of Commerce* index, without adjustment for seasonal variation, for the week ended April 27 rose three fractional points to 93.9 per cent of the 1927-29 average and stood one fractional point below the level two weeks earlier. The adjusted index of *The New York Times* for the week ended April 20 registered a fortnight's advance of four fractional points and a year-to-year gain of seven full points.

Retail trade was irregularly retarded by abnormal weather in the final full week of April. Department store sales during the four weeks ended April 20 were 4 per cent below the comparable 1939 total, according to the Federal Reserve compilation.

Production of electricity by the power and light industry during the week ended April 27 fell to the second lowest level of the year to date and was 9.8 per cent above the corresponding output last year, as against a similar margin of 11.4 per cent a fortnight earlier.

Railway freight movement in the same period, with 644,520 cars loaded, was 2.6 per cent above the figure for the preceding week and 10.1 per cent greater than a year ago.

Bank debits to deposit accounts (except inter-bank items) in leading cities during the week ended April 24 were 18 per cent above the corresponding total in 1939, the cumulative total for thirteen weeks showing a similar gain of 6 per cent.

Crude oil production during the week ended April 27 declined slightly to an average of 3,845,250 barrels daily, exceeding by 295,250 barrels the

required output as computed by the Bureau of Mines; the similar excess in the second week of the month was 303,800 barrels.

Average daily output of bituminous coal in the week ended April 20 was 1,222,000 tons, as against 1,283,000 tons for the week before and only 481,000 tons a year ago, when a strike was in effect.

Engineering construction awards during the week ended May 2, according to *Engineering News-Record*, were 16 per cent below the corresponding 1939 total—a gain of 82 per cent in contracts for private work being more than offset by a decline of 34 per cent in awards for public projects.

Cotton-mill activity declined by the computed seasonal amount in the week ended April 20, *The New York Times* adjusted index remaining unchanged at 130.3, as compared with 121.4 a year ago.

Business failures during the week ended April 25, according to the Dun & Bradstreet report, numbered 311, as against 262 in the preceding week and 326 in the corresponding period last year.

Professor Fisher's index of wholesale commodity prices for the week ended April 26 declined to 84.6 per cent of the 1926 average from 84.8 for the week before.

Excess reserves of the member banks of the Federal Reserve system declined \$10,000,000 during the week ended May 1 from the all-time peak to an estimated total of \$6,110,000,000. Business loans of the reporting members a week earlier exceeded by \$575,000,000, or 15 per cent, the corresponding amount a year ago.

ADVERTISING

W. A. Clabault has been appointed advertising manager of Roller-Smith Co. He was formerly with Westinghouse Electric & Manufacturing Co.

F. L. Edman has been named advertising manager of Reo Motors, Inc. He was previously associated with Reo from 1934 to 1937.

An extensive campaign for automobile horns and radios is planned by Sparks-Withington Co. with announcement of the appointment of Brooke, Smith & French as its agency.

Coincident with the release of "The Making and Shaping of Steel," newest motion picture depicting operations of U. S. Steel Corp. subsidiaries, film distribution centers have been established at company offices in Pittsburgh, Chicago, New York, Birmingham, Cleveland and San Francisco.

Arden Yinkey has been appointed to the staff of Zimmer-Keller, Inc., Detroit advertising agency. He formerly had been associated with several agencies handling automotive accounts and for the past two years had been engaged in public relations work in the east.

Preview Magazine, a monthly magazine, is being issued through the cooperation of Nash dealers. The publication is designed to stimulate the "see America" movement.

The first quarter's newspaper automotive lineage increase of 28.3 per cent over last year's similar period, reported by Media Records, was achieved to a large extent in the first two months. April and May lineage, however, is expected to continue the gains well into the second quarter.

B. F. Goodrich Company, Akron, will sponsor broadcasts of minor league baseball games in 17 key market areas, with a dealer tie-up of schedule distribution by Goodrich outlets.

Wendell H. Welch has been appointed sales promotion manager of Chrysler export division. W. B. Chapoton, advertising manager, takes over the direction of the division's advertising activities.

CENSORED

An exclusive feature prepared by the London correspondent of AUTOMOTIVE INDUSTRIES, M. W. Bourdon.

The annual report of the British Society of Motor Manufacturers issued toward the end of April shows for the first time that the total of new car registrations during the year to September 30 last was 288,686 (September estimated). Despite a big drop in September sales this total is larger than that of the previous twelve months (277,840), but roughly 38,000 below 1937, the peak year. Imports, prohibited in and after September, were down to 6782 for all classes of vehicle; the total was 9371 in 1938 and 15,749 in 1937. Exports of cars (53,983) were an all-time high record, although during the early part of the year a succession of monthly decreases had been recorded.

* * *

New cars registered in February totaled 3849 against 23,509 in February last year; 2950 were of 10 h.p. or under. Trucks numbered 2259 and buses 176, against 4617 and 430 respectively. The reduction in all cases corresponds roughly with that in each month since the outbreak of war.

* * *

Owners of German cars and trucks in England are in a quandary owing to lack of replacement parts. Some have tried to get the required parts specially made but the cost has often been found prohibitive, apart from the difficulty due to there being no mechanical drawings available.

* * *

A growing demand for used cars at progressively increasing prices is anticipated owing to further shrinkage in the output of new cars for the Home market. The ultimate effect is calculated to bring about a "fantastically unreal state of affairs," to quote from an editorial in "Motor Trader." The latter believes that dealers will shortly refuse to sell a new car—if they have any!—unless they are offered an attractive old one in part-exchange, so that they can make a second profit from the subsequent sale of the used car.

Packard Quarter Under 1939 Mark

Packard reports a net income for the first quarter 1940 considerably less than the income for the first quarter 1939. For the period ended March 31, 1940, net profit of \$38,409 was indicated as compared with the net profit of \$230,329 for the same period in 1939.

GM Negotiates With CIO-AFL

Irvan Carey Heads UAW-AFL Group

Negotiations between the General Motors Corp. and the UAW-CIO for a revision of the continuing contract between the union and the corporation began May 7 at Detroit. At a preliminary conference between GM and union officials, both sides agreed to do everything possible to conclude the negotiations within three or four weeks. Five-hour conferences three times a week are being held.

Among the amendments sought to the contract are a general wage increase, vacations with pay, improved seniority system, a recognized shop steward system, and a joint adjustment on disputed production standards.

Representing GM at the negotiations are Floyd O. Tanner, vice-president in charge of personnel; Stephen M. DuBrul, Clarence O. Skinner, H. W. Anderson and Harry Coen, of the labor relations department. Representing more than 126,000 GM workers in 51 plants for the UAW-CIO are Walter P. Reuther, director of the union's GM department; Roy J. Thomas, union president; George F. Addes, William Stevenson and George Merrelli, all of Detroit; Arthur Johnstone, Pontiac; Ed Geiger, Flint, and John W. Livingstone, St. Louis.

Negotiations between General Motors and the UAW-AFL were scheduled to get under way May 10. The UAW-AFL is representing 6000 employees in five GM plants as the outcome of the NLRB election of April 17. The same men are representing GM at the UAW-AFL conferences. Representing the UAW-AFL are Irvan Carey, new president who succeeded Homer Martin after the latter resigned his post April 26; Elmer Dowell, Jerry Aldred, Howard Thompson, and Henry Kaiser.

Martin's resignation as UAW-AFL president came just 10 days after his union was decisively outpolled in the General Motors election. Martin became president of the UAW when the newly organized union left the ranks of the AFL and joined the CIO in April, 1936. He led the union through the sit-down strikes in 1937 but the next year became involved in factional disputes within the union. This resulted in a schism within the union ranks and Martin led his followers back into the AFL. Carey, an international vice-president, was named to succeed Martin.

Victory in the GM election has swelled the ranks of the UAW-CIO to 271,436 members, Addes, the union's secretary-treasurer, reported recently. This is an increase of 29,085 over the March total, according to Addes.

Payment of unemployment benefits to 23,000 Chrysler workers has been tied up by court injunctions and no

decision in the case is possible before May 15. The Chrysler Corporation's appeal of the award of \$1,892,000 in benefits by the Appeal Board of the Michigan Unemployment Compensation Commission was continued until May 15 by Judge Leland W. Carr at Lansing.

A writ of mandamus sought by 11 taxpayer members of the Michigan Manufacturers Association seeking to restrain payment of the benefits because they might result in a boost in the state unemployment tax was to be heard May 11 by Judge Joseph A. Moynihan in Wayne County Circuit Court at Detroit. A third writ was filed

at Detroit by attorneys for the UAW-CIO in behalf of six Dodge workers who maintained they were entitled to benefits which had been denied them by the Appeal Board because it alleged they were directly interested in the dispute.

The Michigan unemployment compensation fund, from which the Chrysler workers will be paid upwards of \$1,892,000 if the Appeal Board's awards are upheld by the courts, will reach a record total of \$63,000,000 during May, according to Harry A. McDonald, commission chairman. The previous high mark was \$62,936,163 on July 1, 1938.



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Continental Motors Corporation
MUSKEGON, MICHIGAN

SERVING THE AUTOMOTIVE INDUSTRY

New Steel Price Set-Up May Come with '41 Commitments

Good Demand for Tool Steel Continues With Prices Reported Holding Steady

Moderate commitments by automobile manufacturers for sheets and strip steel, to be used in the final period of 1940 model assemblies, enabled steel mills to step up their rate of operations the week ending May 11 to 65.9 per cent of ingot capacity. A fortnight ago

they were operating at only 60 per cent. Specifications from automobile manufacturers, however, are held close to current requirements. If steel producers insist upon shipments of steel, bought at \$4 a ton below second and third quarter prices during the brief

"bargain" period in the last week of April, by June 30 the bulge in finishing mill schedules is hardly likely to make itself felt before next month. Meanwhile, primary steel mill departments will be geared to turn out the semi-finished material, and it is this preparatory activity that is chiefly reflected in this week's gain in operations.

It is thought in the steel market that flat rolled steel tonnage on mills' order books from automobile manufacturers represents what there remains of 1940 model requirements and that, when the time for initial purchases of 1941 model steel comes around in July or August, conditions then prevailing may determine a fresh price set-up. While the annual reports of the leading steel companies reveal a relatively high rate of operations in recent weeks, reading between the lines also indicates that the competitive situation has lost none of its acerbity, which leads one commentator to remark that "one must allow for the poker-playing psychology that pervades the sales efforts of the steel companies." Some covering of nearby requirements of carbon and alloy steel bars by automotive consumers was reported this week. There was also a continuance of good demand for tool steel, with prices reported steady.

Copper has eased off further. Although mine producers have not lowered their quotations of 11½ cents, custom smelters are offering spot electrolytic at 11½ cents and in the outside market, some sales at 11.10 cents were reported. Brass mills are operating at from 60 per cent of capacity upwards.

The Procurement Division of the Treasury Department received bids, ranging from 46.70 to 47.56 cents, f.o.b. New York, on 3800 tons of tin. One bidder later declined an order for 100 tons, offered on condition that the tin to be delivered was smelted in this country from Bolivian ores, the reason given being that the bidder's experimental operations in the domestic smelting of these South American ores had not progressed sufficiently to justify guarantees of chemical composition and purity. Steady advancement in this new development is reported, however. The tin market opened quiet the week ending May 11 at 47½ cents a pound for spot Straits. A fractional advance on Tuesday of that week did not alter the situation materially. A \$2 per ton reduction in the price of lead was posted, the intake of custom smelters having for some time exceeded the demand.—W. C. H.

Frederick J. Haynes

Frederick J. Haynes, for years a well-known figure in the automotive industry, died May 3 in Detroit. He was an intimate friend of the Dodge brothers, his acquaintance with John Dodge going back to 1900 when they were associated in the bicycle business. When the Dodges began manufacturing their automobile in 1912, Mr. Haynes was

Automatic Stub Lathe Simplifies Machining, Cuts Cost



Sundstrand Model 8 Automatic Stub Lathe shown above uses tungsten carbide cutting tools effectively to increase production more than 50% on certain cast iron work-pieces, and to simplify machining. Arrows indicate diagrams showing automatic cycles of cutting tools. Rapid traverses are represented by dotted lines, feeds by heavy lines, and tool-relief by light lines. Wide range of speeds and feeds, easy set-up by simple adjustments, high-speed traverses, skip-feed, and other Automatic Stub Lathe features work cutting tools to capacity; cut operating costs, give high production. Close limits and fine finish on this operation make it possible to simplify subsequent machining and secure additional production improvements. Complete information about this job, and Automatic Stub Lathe possibilities for your turning will be supplied promptly on request.

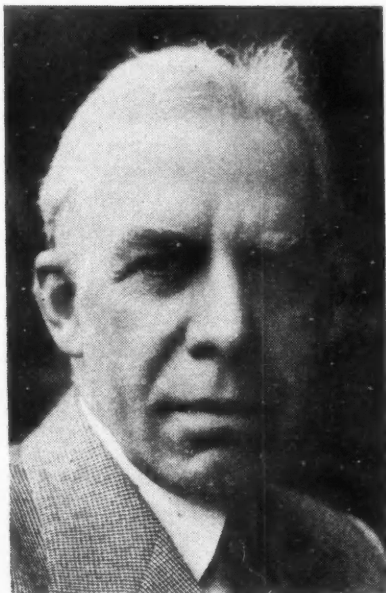
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Many other standard cycles, advantages, details of construction, and specifications of Models 8, 10, and 12 Automatic Stub Lathes are illustrated and described in Bulletin 391 shown above . . . Write for your copy today.



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Tool Grinders - Drilling & Centering Machines
Hydraulic Operating Equipment - Special Machinery



Frederick J. Haynes

brought to Detroit from Syracuse where he had been associated with H. H. Franklin in automobile manufacturing.

He became factory manager of the Dodge plant, then director of purchases. On the death of John Dodge in 1920 he was made assistant general manager under Horace E. Dodge.

When the latter died, in 1921, he became president, serving until 1925. Until the Dodge organization was taken over by Chrysler Corp. in 1928 he served as chairman of the board.

In 1929 he became president of the Durant concern, when W. C. Durant retired. He retired after serving a year.

In 1933 Mr. Haynes was named a member of Detroit's NRA Compliance Board and in 1934 was appointed deputy administrator for the automobile industry. Later he became associated with Gear Grinding Machine Co. and the Automotive Tool & Die Manufacturers Association. He was also president of the Detroit Board of Commerce and served as a director of the National Automobile Chamber of Commerce. Most recently he had been associated with George Wilcox in the invention and production of booster engines for trucks.

PUBLICATIONS

A new catalog, released by Blackhawk Manufacturing Co., contains information and descriptions of three new products in the company's Porto-Power line.*

Fulton Sylphon Co. has published a folder illustrating and giving technical data on its line of metal bellows.*

Westinghouse Electric and Manufacturing Co. has a new booklet describing a twin lamp fluorescent RLM type luminaire.*

The Brookings Institution, Washington, D. C., announces a book, "Labor Relations in the Automobile Industry," written by W. H. McPherson. Copies are available at a cost of \$1.50 each.*

Felters Co., Inc., has printed a booklet covering installations of and information on its Unisorb felt.*

A survey of the latest lighting practice, "Artificial Light and Its Application", has been published by Westinghouse Electric and Manufacturing Co.*

Handy & Harman has had reprinted an article from the *Journal of the American Society of Naval Engineers*. Copies of the reprint, entitled "Silver Brazing Alloys in the Marine Field" are available.*

Fansteel Metallurgical Corp. has just published two bulletins—Tantung Brazed Tip Tools for Cutting Steel and Tantung Welded Tip Tools for Cutting Steel.*

Gar Wood Industries, Inc., has released three new Bulletins. No. 12 covers its line of garbage and rubbish units. No. 15 de-

scribes Gar Wood single, vertical and dual vertical hoists. No. 26 covers trussed under-structure for dump bodies.*

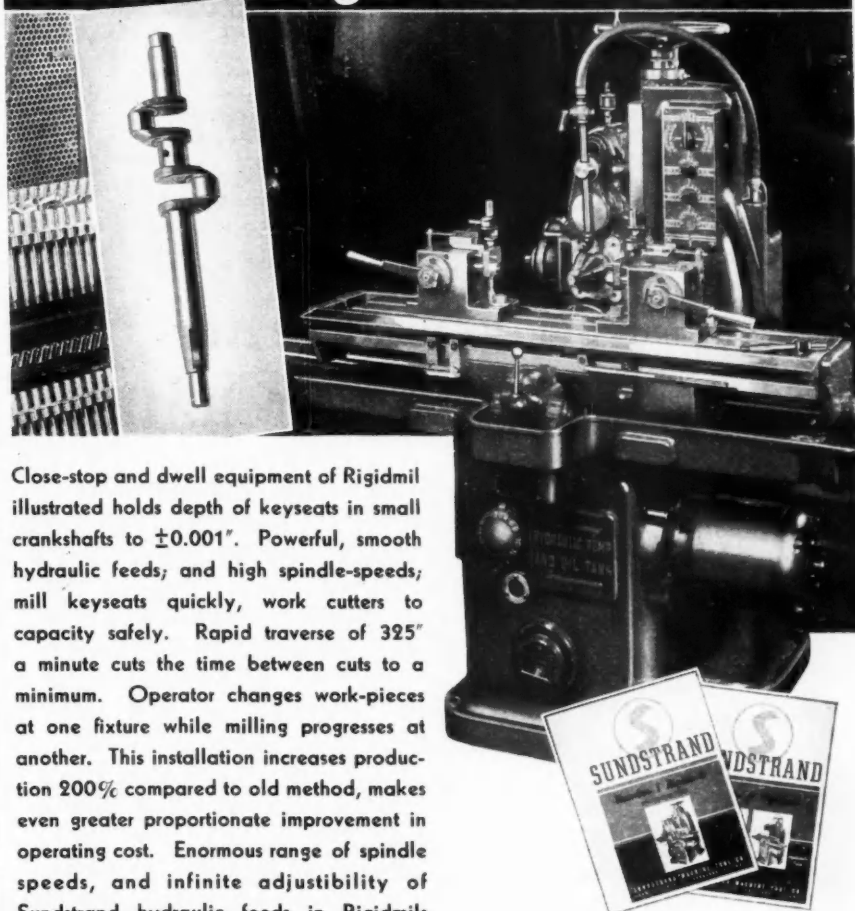
Dodge division, Chrysler Corp., has published a booklet titled "The Experiences of Owners of Dodge-Diesel Job-Rated Trucks."*

A new catalog section on its line of Plastikon rubber putty has been published by B. F. Goodrich Co.*

Behr-Manning division Norton Co. has published several folders covering its Lightning electro-coated abrasive paper and cloth.*

* Obtainable through editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

Sundstrand Rigidmil Holds Plunge Cut To ± 0.001 "



Close-stop and dwell equipment of Rigidmil illustrated holds depth of keyseats in small crankshafts to ± 0.001 ". Powerful, smooth hydraulic feeds; and high spindle-speeds; mill keyseats quickly, work cutters to capacity safely. Rapid traverse of 325" a minute cuts the time between cuts to a minimum. Operator changes work-pieces at one fixture while milling progresses at another. This installation increases production 200% compared to old method, makes even greater proportionate improvement in operating cost. Enormous range of spindle speeds, and infinite adjustability of Sundstrand hydraulic feeds in Rigidmils make these mills similarly productive and economical on all work within their capacities. Look into this! See what Sundstrand Engineered Production can save on your milling.

High accuracy and production are provided by standard Rigidmils on a wide variety of other operations. Bulletins shown above have complete illustrated data on No. 0 and No. 1 Rigidmils. Write for your copies today. Ask for Bulletins 382 and 383.

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Tool Grinders - Drilling & Centering Machines
Hydraulic Operating Equipment - Special Machinery



Ourselves & Government

A Check List of Federal Action Corrected to May 9

NATIONAL LABOR RELATIONS BOARD

Ruling for CIO-AUW, Board has directed the Ford Motor Co. to post notices in its St. Louis plant that company will not interfere with employees' right to self-organization; to bargain collectively with the union and to reinstate

94 employees with back pay. (See story, page 482.)

Board has announced a decision based upon a stipulation requiring Robbins Tire & Rubber Co., Muscle Shoals, Ala., to withdraw all recognition from Muscle Shoals Independent Rubber Union and completely disestablish that organization as a collective bargaining agency for any of its employees. Pursuant to the stipulation, the board dismissed the complaint in so far as it alleged the company had refused to bargain with AFL's Federal Local Union No. 21994, or had discriminated against union employees.

FEDERAL TRADE COMMISSION

VS. GENERAL MOTORS. FTC attorneys given until May 20 to file brief taking exception to trial examiner's report. Case involves Commission allegation that GM dealers were required to handle GM parts to the exclusion of others.

F.O.B. PRICE CASE—Trial examiner's report next development expected in the Ford case. Testimony closed in GM case, after respondent waived oral argument. Trial examiner's report, commission brief and respondent's reply brief all filed. Mailed to respondents on April 18 was FTC supplemental brief.

FAIR TRADE PRACTICE RULES—NADA granted extension of time to file brief in opposition to FTC's proposed rules. Other statements, also in opposition, have been filed.

LABOR DEPARTMENT

Minimum steel wage rates ranging from 45c. in the South to 62½c. in the East, fixed in January 1939 by the Secretary of Labor under the Walsh-Healey Public Contracts Act but later suspended by court injunction, will become effective on May 24 as a result of a Supreme Court decision on April 29.

Briefly, the court said in an eight-to-one opinion written by Justice Hugo Black that the seven Eastern steel producers had suffered no injury and had no standing in court; that determinations made by the labor secretary under the Walsh-Healey law were not subject to court review; and that courts should exercise a "hands-off" policy with respect to purchasing activities of the Federal Government.



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Also available accurate to within $\pm .000004$ inch and $\pm .000002$ inch.

Now you have to SPLIT THE SPLIT HAIR

● With demands for precision in the 1940 contracts more exacting than ever before, your need for Johansson Gage Blocks is greater than ever before. They are unexcelled as a means for achieving — and maintaining — the highest precision.

MOST JOHANSSON BLOCKS ARE AVAILABLE CHROME-PLATED

Write now for the free catalog listing all sets, prices and precision accessories. Individual blocks as low as \$3.50. You will find the blocks listed that will help you meet the new demand.

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BOOKS

A SURVEY OF THE SCIENCE OF HEAT TRANSMISSION, by Dr. Max Jakob. Research Bulletin No. 68 of the Engineering Experiment Station, Purdue University, Lafayette, Ind.

This bulletin is a reprint of three lectures on the subject indicated by the title which were delivered at Purdue University by the author, who is research professor of mechanical engineering at Armour Institute of Technology. Heat transmission is a very complicated subject, inasmuch as heat is transferred in three different ways, by conduction, convection, and radiation. Heat conduction, says Dr. Jakob, consists in elastic impact in the case of gases, in longitudinal vibration in the case of solid conductors, and in electronic movement in the case of metals. Heat convection is governed by the laws of aerodynamics and hydrodynamics, while heat radiation, in its geometry as well as in its dynamics, is a branch of optics.

The three lectures contained in the bulletin develop the science of heat transmission on a historical basis, starting with the earliest expressions for the laws of heat conductivity and heat convection by Fourier and Newton, respectively, and bringing it up to date. Much of the recent work on this subject was done in Germany, and Dr. Jakob had an important share in this development. The bulletins should prove of interest and practical value to all those whose work involves the solution of problems in heat flow or heat transmission.

INDEX TO A.S.T.M. STANDARDS.
(Including Tentative Standards.) Published by the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa.

The latest edition gives information on all of the 885 standards as of Jan. 1, 1940. The Index is of service to anyone wishing to ascertain whether the society has issued standard specifications, test methods, or definitions covering a particular engineering material or subject and it is of help in locating the standards in the volumes where they appear.

All items are listed in the Index under appropriate key-words according to the particular subjects they cover. As a convenience a list is given of the specifications and tests in numerical sequence of their serial designations.

Copies of this 152-page publication are furnished without charge on written request to A.S.T.M. headquarters.

CALENDAR

Conventions and Meetings

American Iron & Steel Institute, Annual Meeting, New York.....	May 23
Automobile Manufacturers Association, Annual Meeting, Detroit.....	June 6
SAE Summer Meeting, White Sulphur Springs, W. Va.	June 9-14
Automotive Engine Builders Association, Convention, St. Louis, Mo.,	June 10-13
American Society for Testing Materials, Annual Convention, Atlantic City, N. J.	June 24-28
National Industrial Advertisers Association, Annual Meeting, Detroit,	Sept. 18-20
American Society for Metals, Annual Meeting, Cleveland, Ohio.....	Oct. 21-25
American Welding Society, Annual Meeting, Cleveland	Oct. 20-25
Aeronautical Chamber of Commerce of America, Inc., Annual Meeting, New York	Dec. 5
National Association of Manufacturers, Annual Meeting, New York....	Dec. 9-13
National Automobile Dealers Association, Convention, Pittsburgh, Pa.	Jan. 20-23, 1941

Shows at Home and Abroad

National Automobile Show, Grand Central Palace, New York	Oct. 12-19
Detroit Automobile Show	Oct. 12-19
Pittsburgh Automobile Show.....	Oct. 19-26
National Metal Congress & Exposition, Cleveland, O.	Oct. 21-25
Chicago Automobile Show....	Oct. 26-Nov. 3
Automotive Service Industries Show, Chicago	Dec. 9-14

Revealing Tests Produce New Fuel Data

(Continued from page 451)

had already been driven over 100,000 miles each. These six cars then were driven, one after another, over a measured one-mile course at Daytona Beach with electric-eye timing, in both directions to eliminate wind effect.

The overall combined average top speed for the three cars, Chevrolet, Ford and Plymouth, was 79.83 m.p.h. for the new cars and 77.95 m.p.h. for

the tested cars which had already been driven 103,000 miles each, indicating a loss in top speed of only 1.88 m.p.h. or 2.35 per cent. Taking the three makes of cars individually, one showed a loss in top speed of 3.48 per cent, another of 1.84 per cent, and the third of 1.81 per cent.

In concluding his talk Doctor Delbridge remarked that the acceleration and top-speed data both gave convincing evidence that with these 1940 cars, the fuel, the motor oil, the lubrication service, and the mechanical maintenance are far more important than the age of the car, measured either in months or in miles.

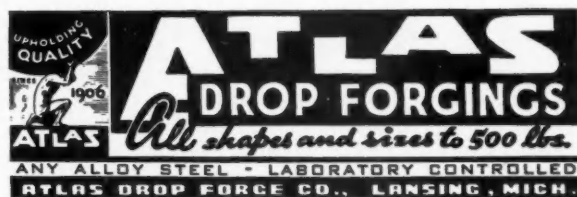


THE ORIGINAL QUOTED PRICE of a Drop Forging is an elusive measure of value. Estimates that sound cheap at the beginning too often prove dear in final machining.

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*A Forging is More than just a Shape and a Symbol
Number at Atlas*



MEN and MACHINES

(Continued from page 455)

few pounds capacity to one containing tons of the drying agent. Continuous or intermittent types that are fully automatic in operation or of manual control can be furnished.

"POWER-PAK," a new line of Diesel-electric power plants, ranging in size from 3600 to 24,000 watts, has been placed on the market by Lister-Blackstone, Inc., Milwaukee, Wis. These new plants consist of a

radiator cooled engine, generator and control panel, all assembled in compact form. The principal departure from conventional design is in the placement of the generator directly underneath the engine. Generators are available in any desired voltage or current, either d.c. or single or three phase a.c., for stationary or marine service.

OTHER new developments, in brief, are the following: A new device

for remote control of Wilson "Hornet" arc welders built by Wilson Welder & Metals Co., Inc., New York. It allows minute adjustments in current output by merely touching one or two contacts on the electrode holder to the ground; Multiple cutter turner for turret lathes which makes several reducing cuts simultaneously announced by the Gisholt Machine Co., Madison, Wis. Available in several sizes which permit turning diameters as small as $\frac{3}{4}$ in. and as large as $4\frac{3}{4}$ in.. Two forged steel flexible couplings with $1\frac{1}{8}$ -in. and $1\frac{3}{8}$ -in. maximum bores respectively added to the line manufactured by Ajax Flexible Coupling Co., Westfield, N. Y. They are designed to meet the present trend of using alloy steel shafts carrying a high percentage of their torque capacity. Flexible shaft machine designed for easy portability around factory floor or yard built by Stow Mfg. Co., Inc., Binghamton, N. Y. It makes use of a two-wheel truck mounting which carries either the direct connected motor-and-shaft unit or the multi-speed belt-and-pulley driven unit. Work rests for supporting work in machine tools and other metal working machinery now supplied with Kennametal inserts by the McKenna Metal Co., Latrobe, Pa.—H.E.B., Jr.

Publications Available on Machine Tools

A line of static and dynamic balancing machines for locating and measuring unbalance in rotating parts is announced in a booklet recently released by the Gisholt Machine Co., Madison, Wis. Detailed explanations of the effects of unbalance in rotating parts are included in the booklet, which also contains diagrams and descriptions of the underlying principles of modern methods for correction as employed by the Gisholt machines.*

The "Hi-Eff" drill press, product of Taylor Mfg. Corp., Milwaukee, Wis., is the subject of a new bulletin entitled "Drill Holes 0.002-in. Diameter Economically."*

"Everything for Safety," is the title of a catalog prepared by the Boyer-Campbell Co., Detroit. Some of the principal subjects covered are eye, face and ear protection; machine tool guards of various types; safety tongs; vacuum lifters; ejectors; clothing and gloves.*

The Norton Co., Worcester, Mass., has brought out a pamphlet which discusses grinding and finishing with portable equipment.*

Gisholt Machine Co., Madison, Wis., has prepared a new catalog of its standard tools for the Gisholt Nos. 3, 4 and 5 ram type universal turret lathes.*

Cam grinding equipment manufactured by Ohio Units, Dayton, Ohio, for production grinding of out-of-round



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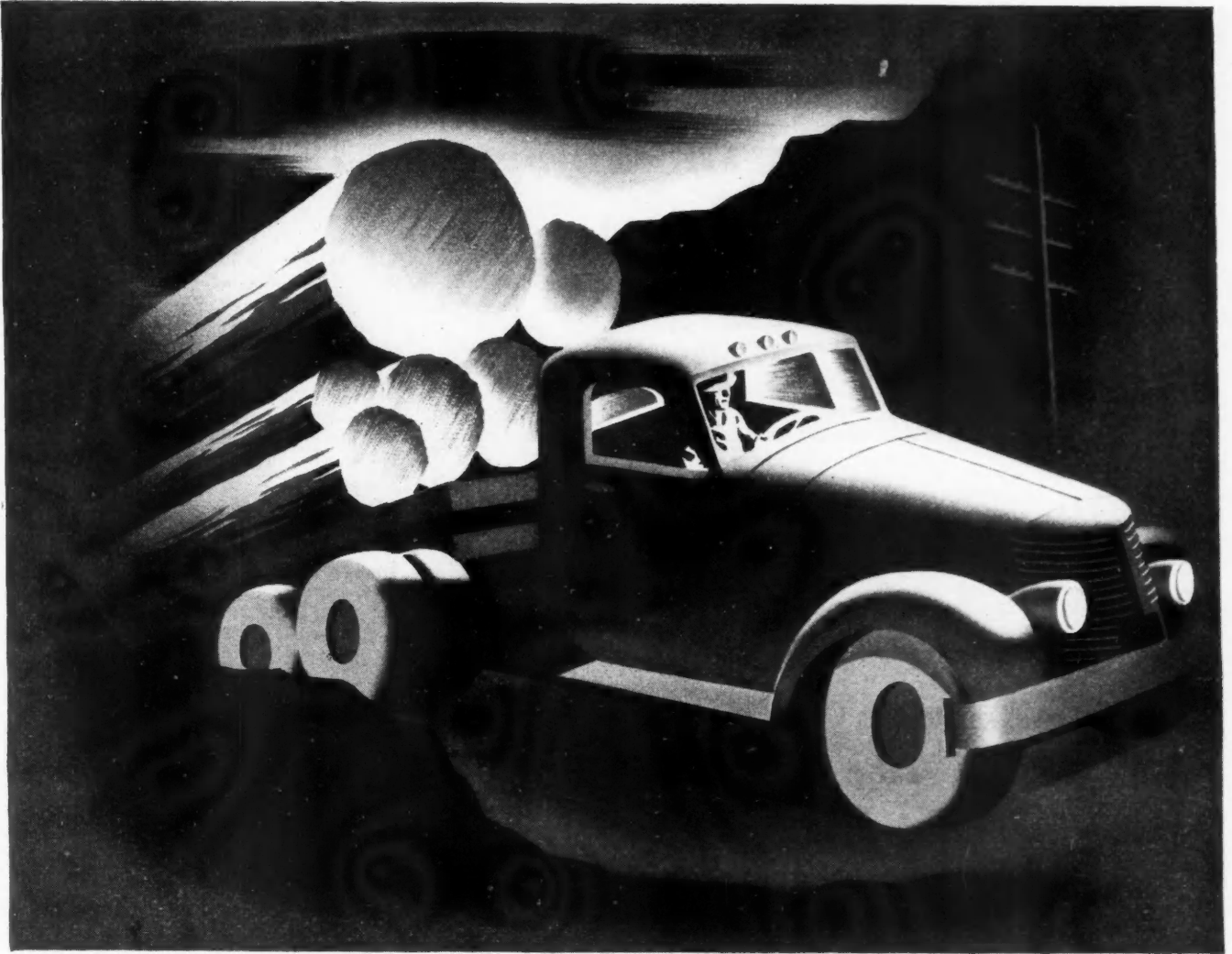
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A CASE IN POINT...

Making sure of dependable performance while keeping costs within reasonable limits is a problem common to manufacturers in practically every line.

Frequently it is solved by a change in specifications to take advantage of the capabilities of modern materials.

A manufacturer of logging trailers, for example, finds that the use of cast Chromium-Molybdenum Steel (0.25 – 0.35% Molybdenum) for couplings has brought worthwhile economies while actually bettering performance.

The steel casts well in intricate patterns and a

simple heat treatment develops the necessary tensile strength and hardness. Thus the manufacturer, using a comparatively inexpensive steel and economical fabrication methods, turns out couplings which, while weighing only about twenty-eight pounds, can be trusted to stand up under pulls as high as 77,000 pounds.

A re-check of your own specifications may disclose similar opportunities. You will find our technical book, "Molybdenum in Steel", helpful. It is sent free on request to interested production executives and engineers.

PRODUCERS OF MOLYBDENUM BRIQUETTES, FERRO-MOLYBDENUM, AND CALCIUM MOLYBDATE

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shapes to precision limits is the subject of a recently issued bulletin.*

An eight-page booklet describing *variable-voltage planer drives* has been published by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

Hannifin hydraulic cylinders are the subject of bulletin 35-B issued by the Hannifin Mfg. Co., Chicago. Models BN and B2N cylinders with swivel mountings, illustrated in this bulletin, are a new type of standard mounting, making seven standard mounting types now available in the Hannifin line.*

The Jessop Steel Co., Washington,

Pa., has prepared an interesting booklet on *die steels*. Details of Jessop 3C, a high carbon, high chrome tool steel of improved machinability are given.*

*Obtainable through editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

The Futurama—1940 Model

(Continued from page 448)

might quickly offset adverse propaganda directed at commercial haulers and the highways.

In this book interpreting the Futurama, Geddes points out that: "It took years to get the automobile out

of the horseless-carriage stage. The inevitable conclusion is that highways will have to go through the same upheaval . . . sooner or later." So it would appear that neither Geddes nor the General Motors Co. have any illusions of speedy arrival of the "highway revolution."

"The present-day automobile functions in competition with high-speed airplanes and locomotives," he continues. "If there is to be any justification for its existence, it must match them in efficiency. To do this, it is not enough to build an efficient automobile . . . the route is as important to the vehicle as thread is to a needle."

Ultimate influence of a second season of the Futurama at the World's Fair remains to be determined next Fall. If, after being viewed by another 5,000,000, many for the second or third time, the idea sinks in that the "route is as important to the vehicle as thread is to a needle," there may be signs of real action. That it will continue to draw the public is indicated by reports that visitors came last year and plan to come to New York this year, in many cases, "to see the World's Fair and the Futurama." Perhaps the argument for planned highways will begin to be more impressive to the public this year than last. The logic is certainly available if the argument can be impressed.

To again quote from "Magic Highways": "The railroads did not stop at serving an already-established population east of the Mississippi. They took the population out beyond the Mississippi . . . They knew that if men were taken out there they would soon create produce, and that the railroads would prosper by carrying that produce eastward. Therefore, the railroad sent its rails out ahead of the population. But highways have always followed the population. Today, America has left the stage where hasty road building in the wake of an increasing population is necessary . . . A planned highway system would take people from points of congestion toward the unexploited lands of the West."

It's a new dream of empire that has been created and visualized for the public by General Motors Co. and Norman Bel Geddes. But the question this year as it was last, is "how long will it take for the public to get the basic idea?" Meanwhile, the Futurama promises to continue playing to capacity houses, for it is stirring the public imagination as nothing else did at the 1939 Fair, or so far promises to do in this new season.



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